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ON THE MOTOR DEFICIT IN CONGENITAL BILATERAL ATHETOSIS

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INTRODUCTION

The term "athetosis" meaning "without fixed position," was introduced by Hammond (18) who stated, "It is mainly characterized by an inability to retain the fingers and toes in any position in which they may be placed, and by their continual motion." He noted that the "involuntary" muscular movements of the fingers and toes were "not those of simple flexion and extension, but of more complicated form." The movements were slow, "apparently as if with deliberation and with great force," and paroxysmal. During the continuation of the movements the arm was "hard and rigid," and the calf of the leg was in a "state of tonic spasm" while the toes were in motion. He described a peculiar posture of the hand, with the little finger strongly abducted, the ring finger less so, the middle finger slightly flexed, the index finger extended, and the thumb extended maximally.

Shaw (31) discussed bilateral athetosis, and quoted Gairdner's description, "Sometimes the wrist is strongly flexed and at other times it is strongly extended, and very often the fingers are in precisely the opposite position to the wrist; sometimes individual fingers are flexed while others are extended and all more or less rigid." Shaw himself described movements of the head and face, consisting of a slow protrusion of the head forwards and upwards, or to one side or the other, and then of its retraction downwards and to the other side. He described movements around the mouth, especially bouts of retraction of the lips and relaxation, and slow protrusion and retraction of the tongue. Movements of the fingers seemed "independent one of the other, for not only do they bend and extend themselves capriciously, out of unison with the others, but the flexions happen now at the second, then at the proximal joint, while the forearm is ever on the move from pronation to supination and back again." These movements were more prominent in the distal segments of the extremities than in the proximal. The gait was a "pseudotabic" gait and the patient often protruded the abdomen and kept the shoulders well back when walking.

Anton (1) pointed out the frequent asymmetry of disorder, the occurrences of associated movements and noted the frequent contraction of the antagonists first in an attempt at willed movement, this latter phenomenon being especially prominent in the leg. The movement disorder became more apparent as the patient tried harder to make a voluntary movement.

Foerster (11) has provided an extremely detailed description accompanied by a wealth of photographs of the motor disorder in double athetosis. He not only described the relatively slow combinations of movements in the face, hands and feet in all of their multifold combinations and var-

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iations, but also documented the presence of associated movements, in general as an identical mirror image in one limb of the "willed" movement in another, and mass movements involving not only all the limbs (generally as an extension movement), but also the head and trunk (flexion or retraction). He also pointed out that these movements consisted primarily of motor synergies, for example, a flexion synergy of the leg consisting of flexion and abduction of the leg with supination of the foot and extension and abduction of the great toe, or an extension synergy consisting of extension and adduction of the leg with plantar flexion of the foot. In the upper limbs extension of the arm was associated with pronation of the hand, and flexion with supination.

In recent years the term "athetosis" or "athetoid" has come to be regarded as an entity in the classification of cerebral palsy. With Wyllie (41) we regard this unrestricted use of the term as unfortunate, for it is clear from description in more recent literature that many patients called "athetoids" do not exhibit the phenomena of athetosis as understood by the neurologist and as originally described by Hammond, Shaw and others. Furthermore, such unrestricted use of the term artificially compartmentalizes a group of disorders, and obscures a possible relationship with the other clinical aspects of cerebral palsy.

In our experience (35) athetosis occurs relatively infrequently in pure form. Its association with infantile spastic hemiplegia is well known and bilateral athetosis frequently complicates spastic diplegia or quadriplegia. Regarding this it is of interest that Carpenter (2), in his recent study of the relation of athetosis to lesions of the basal ganglia, questioned the presence of athetosis in all cases so described, and commented on the lack of detailed description of differences in cases. He also noted that bilateral paresis and "spasticity" were present in half of the cases of "double athetosis."

We would suggest that some general relationship exists between the various clinical syndromes of cerebral palsy as defined by Kurland (24) for our own studies suggest that any differences may be more apparent than real. In many respects the movement deficits in the "spastic" syndromes are of the same physiologic nature as those of bilateral athetosis (34, 35). Indeed the Vogts (36) have suggested that congenital double athetosis is only a more intense form of "Little's disease." Marked similarities are also evident in Foerster's paper (10) on "spastic syndromes," and more recently Denny-Brown (4) has commented on the probable relationship of these various clinical syndromes.

In this paper we shall be concerned with some of the physiological aspects of congenital bilateral, or generalized athetosis (double athetosis) *not accompanied* by spasticity, or cerebellar symptoms (as frequently observed in Kernicterus). The patients have been children, ranging from three to fourteen years of age, and all have exhibited athetosis in addition to other deficits in motor function associated with this phenomenon. Some asymmetry of involvement has been common, as has been also a greater disability in use of the lower extremities than the upper.

GENERAL DESCRIPTION OF THE MOTOR DEFICIT

At complete rest, either lying on a bed in any position, or sitting quietly in a chair with the trunk rested against the back of the chair, the patient exhibited no abnormal or "involuntary" movements in any part of the extremities, head or trunk. This absence of extraneous movement occurred with the patient relaxed, but not necessarily asleep, as in all instances full awareness was maintained. Indeed, it was possible to place many patients in a standing position, giving light support so as to allow maintenance of balance, in which instance the patient could become so relaxed that again no abnormal movements occurred even in this position.

On the other hand certain abnormalities of posture of the limbs might obtain in any of these positions, but these will be detailed in a later section. Aside from these postural abnormalities, however, one would not be impressed with any disorder of motor function with these patients in the resting state.

The abnormal movements characteristic of athetosis were precipitated by a variety of circumstances. Thus, they were set off by attempts at postural adjustment, or by an attempt at voluntary movement of any sort in any segment of the body; and any "willed" movement might produce characteristic athetosis in another part. Thus willed movement of an upper extremity could cause athetosis in the same limb or in the other limb and/or also in the lower extremities and face. An attempt to speak could initiate athetosis in the hands or feet, as well as the face. As the willed effort was intensified, so the abnormal movements increased in amplitude and violence. In many respects emotional situations seemed to provoke athetosis, more readily than any other. Thus, if the patient was tense or slightly apprehensive at the approach of a stranger, or under the situation of a medical examination, athetotic movements were striking.

Athetosis was most prominent in the upper extremities, less marked in the face, and then occurring particularly around the mouth, and least marked in the lower extremities. Again, athetosis was most apparent in the distal segments of the extremities. In the upper extremities the phenomenon was characterized by slow, periodic, arrhythmical changes of posture in the fingers. Thus, if the fingers were primarily flexed in a "resting" state, they would periodically extend and flex again; or if generally extended at rest, they would flex periodically. There might be a number of cycles of flexion and extension, either of approximately equal or unequal velocity, or there might be only one cycle of flexion and extension followed by a period of relative quiescence. The alternating flexion and extension might be complete or incomplete, so that oftentimes only fragments of a full swing from complete flexion to extension were apparent. The movement might be one of flexion of half-closed fingers with a return only to the apparent resting posture, or it might be one of varying degrees of extension of half-closed fingers with return only to the resting posture and not followed by complete flexion of the fingers. Flexion of the fingers might occur at either the metacarpophalangeal joints, or the interphalangeal joints. Extension or flexion of fingers might occur relatively simultaneously, or one finger might flex or extend after another in sequential fashion. Not uncommonly certain fingers flexed while others extended. Extension of the fingers was usually associated with abduction of the fingers, and flexion with some adduction. Extension or flexion of fingers might be accompanied by either flexion or extension of wrist[2], and frequently extension of fingers occurred with flexion of the wrist, producing the well-known "athetoid posture" of the hand. Pronation of the wrist often occurred with extension of fingers, while supination accompanied flexion of fingers. With extension of the fingers the thumb also usually extended and abducted, but occasionally might extend and adduct. The fingers sometimes closed around a thumb flexed at the metacarpophalangeal joint, so as to trap the thumb between the fingers.

Movements of the head constituted swings of variable degree from side to side, associated with dorsi- and ventroflexion. The jaw might strongly deviate to one side as the head swung to the opposite. As in the hands these movements might be only fragmentary of a complete cycle. Abnormal movements were particularly frequent around the mouth, in which pursing or puckering and protrusion of the lips alternated with retraction of the corners of the lips, or

[2] Flexion of fingers and toes, or hand (wrist) implies palmar or plantar flexion; extension of these parts implies dorsi-flexion.

wide parting of the lips. The tongue might protrude and retract slowly and periodically. These movements were especially apparent when the patient attempted speaking, but also obtained on attempt at movement of the trunk or extremities.

Athetosis was least common in the feet, but when present was similar to that in the hands, being primarily an alternation between flexion and extension of the toes, adduction again associated with flexion and abduction with extension. In general, the toes moved together, but occasionally the great toe moved in an opposite direction to the others, so that extension and abduction of that toe might occur together with flexion of the other toes. Less frequent was a sequential alternation of flexion and extension of all the toes.

The abnormal movements so far described have been those of distal limb segments and of the head, and characteristic of the phenomenon of athetosis as originally described by Hammond (18) and Shaw (31). Abnormal movements also occurred, however, in proximal limb segments and trunk, but a description of these shall be postponed to a later section.

The most striking movement disorder occurred when the patient attempted voluntary use of the limbs. It was particularly difficult for the patient to extend the upper limb in order to reach for an object. Very often an effort to extend the limb succeeded only initially in producing increased flexion of the limb, an opposite reaction to the one desired. Thus, as one patient attempted to reach for an object the arm abducted strongly at the shoulder, flexed at the elbow and pronated at the wrist, so that the hand approached the side of the head with the fingers and thumb strongly extended and abducted (Figure 1). As the effort to extend the limb was increased, the hand would remain relatively in this position with simultaneous contraction of flexors and extensors, then going on to a violent flexion-extension tremor at the elbow before finally extending ataxically toward the object. During this whole process the fingers might remain either extended, or flexed strongly, or might exhibit the alternating movements of athetosis. It seemed as if the hand actually "preferred" to back away or withdraw from the sought-after object. All patients exhibited some degree of difficulty in extension of the upper limb, although not always as pronounced as in this patient. Most often extension was slow and deliberate, accompanied by a moderate amount of ataxia. Because of this difficulty in extension the patient oftentimes bent his head, and sometimes the upper trunk strongly forward, so as to get the upper extremity closer to the object desired.

Equally prominent was a difficulty in adduction of the upper limb which occurred in varying degrees in all patients. Indeed, after some patients got the arm extended, it remained extended widely at the side because of an inability to adduct the limb toward the midline. Because of this difficulty the patient commonly had to turn the upper trunk to bring the hand around to the object.

Flexion movements on the other hand, although ataxic, were not so difficult to perform and seldom provoked an antagonistic extension movement.

Once the hand could be brought close to the object there was generally a wavering ataxia, and at this moment the limb might abduct and flex away from the object, or the hand might actually touch and palpate the object, only to withdraw again (Figures 2B and 3). The hand generally approached the object with fingers widely extended and abducted; there appeared to be extreme difficulty in getting the fingers to close around the object, and every attempt to flex them frequently resulted in an increased extension and abduction of the fingers. Less frequently the hand approached the object with the fingers flexed strongly, in which instance it then appeared difficult for the patient to open the hand in order to grasp the object.

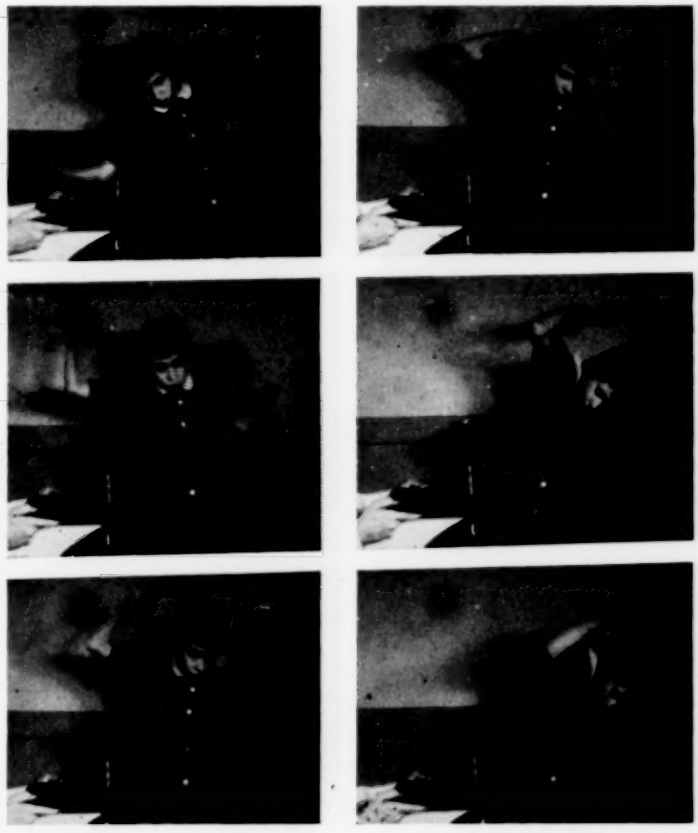

FIG. 1. Selected frames from motion picture film to show patient reaching toward object with right hand. (Read from above down, left to right). Entire action required six seconds before object could be reached.

The closed hand itself might touch the object and then fly off following contraction of antagonistic muscle groups (Figure 4).

In some patients the initial flexion of the limb away from the object was accompanied by a turning of the head and eyes, and indeed the whole upper trunk away from the object towards which the patient was to reach, and in such instances there was of course a misdirection of vision, so that the patient could not see the object towards which he was reaching. In other patients, however, there seemed to be marked disorder in "hand-eye coordination" and even though there was no movement of the head and eyes away from an object, patients oftentimes would strike out wildly at an object without looking at it.

Once an object was grasped it might be immediately dropped following wide extension and abduction of fingers and thumb. Some patients, however, were able to grasp an object but then had difficulty in releasing it. It became evident that if the object grasped, touched the ulnar part of the hand it was more likely to be dropped. If grasped in the medial part of the palm a difficulty in releasing the object was more apparent. In like manner if the patient grasped the examiner's fingers with the medial part of the hand, one could detect a tightening of the grip as the patient attempted to release the

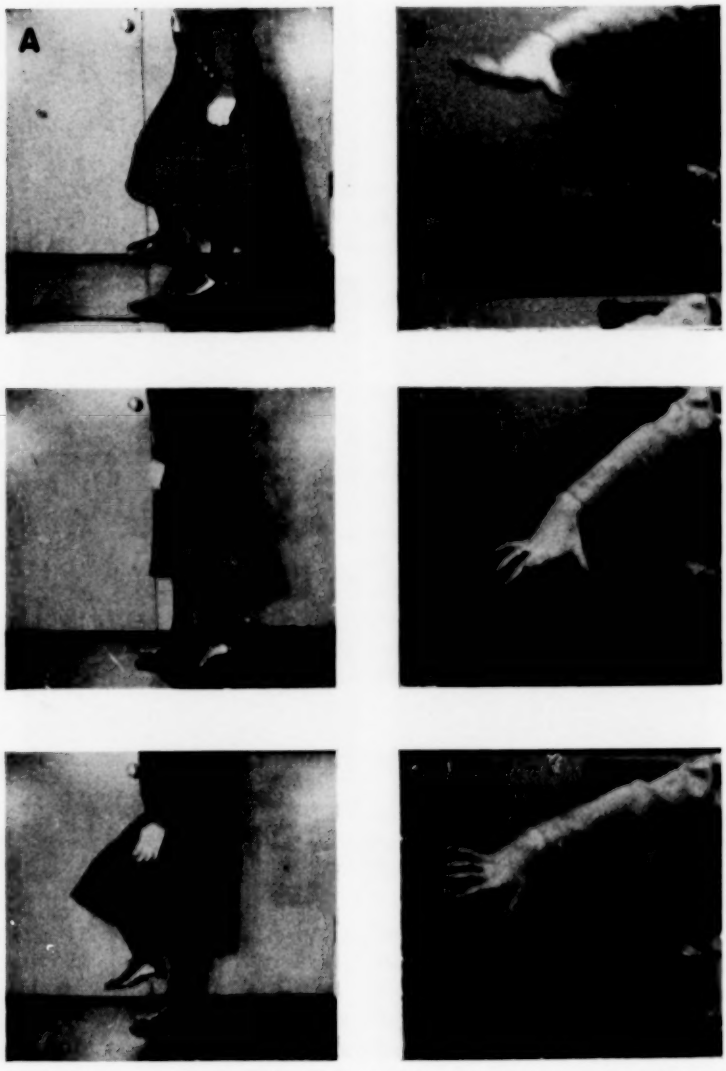

FIG. 2. A: to show over-flexion of legs when walking. B: to show over-extension and abduction of fingers as hand approaches object. Index finger touches object (middle frame) and withdraws (lower).

grasp. As the fingers flexed to grasp an object, marked flexion of the wrist also occurred rather than the synergistic wrist extension of the normal grasp. As the object was gripped more tightly, the wrist flexed even more and was then associated with synergistic flexion of elbow and shoulder.

A disorder of facial movement was observed when these patients attempted to speak and this was more apparent when there was an attempt to pronounce a plosive sound, such as P or B, in which approximation of the lips is required. Such a movement was first preceded by variable degrees

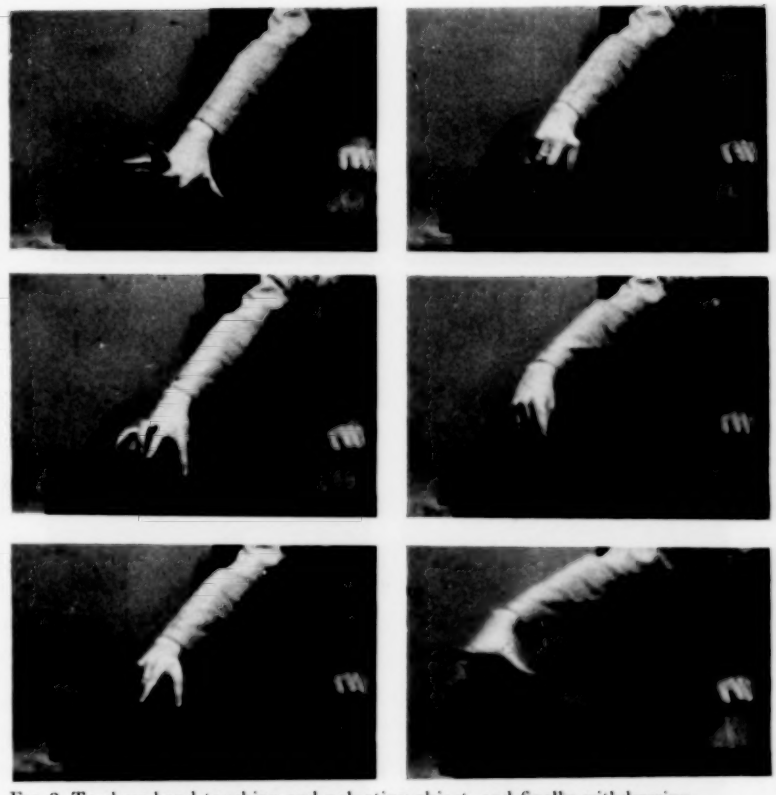

FIG. 3. To show hand touching and palpating object, and finally withdrawing.

of opening of the mouth, which was then followed by a slow, poorly sustained approximation of the lips. Opening of the mouth might be accompanied by retraction or protrusion of the tongue, but closing of the lips seemed to be accompanied more by protrusion of tongue if such occurred at all. Both approximation and separation of lips could be produced voluntarily by the patients, the latter more easily than the former.

The patients had varying degrees of ability to change position of the body and to sit, stand and walk. Thus, all could change from supine to prone, or vice versa. Various differences in head control were observed and will be discussed in the next section. Once in the prone position the trunk could be elevated by extending the arms and it was possible for all the patients to crawl. Sitting was generally accomplished, if possible at all, by rolling from supine to prone and then getting into a sitting position in an infantile quadrupedal manner, rather than by flexing the trunk from the supine position in the mature manner.

The so-called associated movements were frequently seen in these patients occurring as similar or reciprocal movements in limbs other than those being voluntarily moved. They were particularly prominent in the upper limbs. Thus, attempt at willed finger flexion of the right hand could induce flexion of the fingers in the left hand. Or flexion of the right arm might induce either flexion or extension of the left arm (Figure 1) and such movements then occurred as movement synergies as described earlier by Foerster

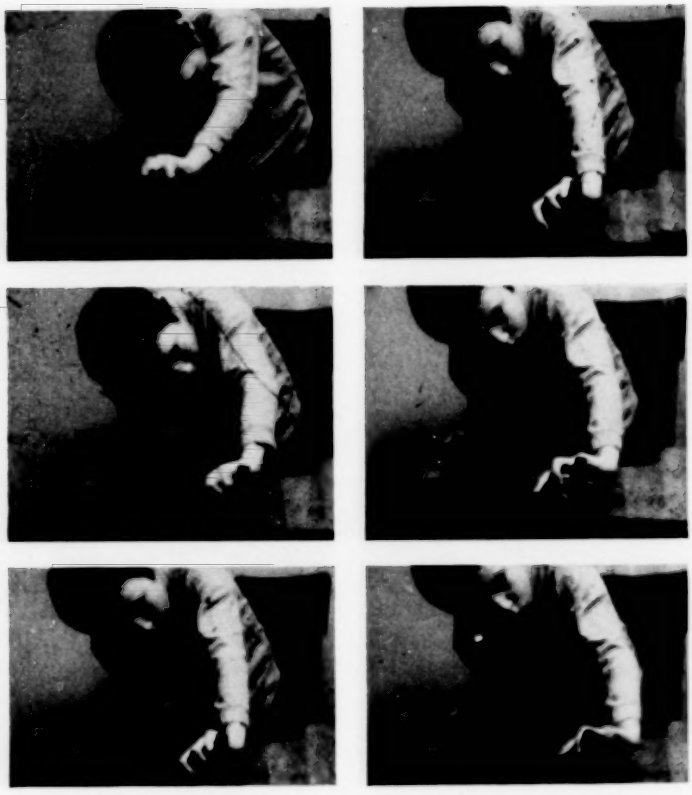

FIG. 4. Closed hand approaches and touches object, opens and then withdraws.

(11). Associated movements could be of equal or lesser range to that of the voluntarily moved limb.

In like manner mass movements were present under a variety of circumstances. They involved all four limbs, usually consisting of extension and abduction synergies of all, often associated with retraction of head and trunk. They were rapid, phasic movements of short duration. They too might obtain upon any attempt at willed movement, but were more prone to occur on attempts to change position of the body in space, or to maintain a sitting or standing balance in those patients having such ability. Mass movements were also a prominent accompaniment of sudden emotional stimuli, such as a loud noise (Figure 5D).

A peculiar defect of gait was noted in those patients who could walk. First of all, there was a tendency for the head and trunk to be thrust backwards and a tendency for the patient to fall backwards. This movement of head and trunk occurred in certain degrees of violent jerks of short duration. Associated with these violent movements of head and trunk were oftentimes violent movements of extension and abduction of the upper extremities, and extension of the lower extremities which themselves might throw the patient off balance. In those patients who could walk, a marked over-flexion of hips and knees occurred associated with over-flexion of the feet (Figure 2A). This resulted in a strange shifting, ataxic gait in which hip flexion was particularly remark-

able. With flexion of the legs there was also some abduction at the hips, and with flexion of the feet a marked dorsiflexion and abduction of toes occurred. The foot often appeared to suddenly spring from the floor. The patient moved slowly as the feet were not advanced far enough. Patients unable to walk alone, when supported also showed this peculiar over-flexion of the lower extremities when attempting to take steps. Over-adduction of the limbs or scissoring gait was not observed in any of these patients.

Some asymmetry of motor deficit was apparent in all of these patients, so that the ataxia or abnormal movements of one limb would be more prominent than another. In walking one limb might overflex more than the other, and in like manner it might be more difficult for the patient to extend one limb than the other. Indeed, in one patient, whereas the right hand most often approached an object with fingers widely extended and abducted, the left hand more frequently approached with the fingers strongly flexed.

Strength was apparently diminished throughout for all movements. In general this appeared to be more of a difficulty in maintaining a strong contraction, for at the initial moment of contraction in any muscle group one could detect considerable strength of contraction. In the limbs the apparent weakness was more prominent in distal parts, that is, in the hands and feet, than in proximal.

In general some form of the difficulties described above obtained in all the patients. There were differences of degree, however, so that the movement disorder was not so prominent in one patient as in another. It has been noted that some patients could stand and walk, others could not, and there were certain differences from the usual resting posture to be described later, but it was established that at one time or another all the patients had presented similar manifestations of motor defect. The significance of the differences will be discussed in a later section.

RESTING POSTURE

The resting posture in the supine position was striking, particularly in the upper

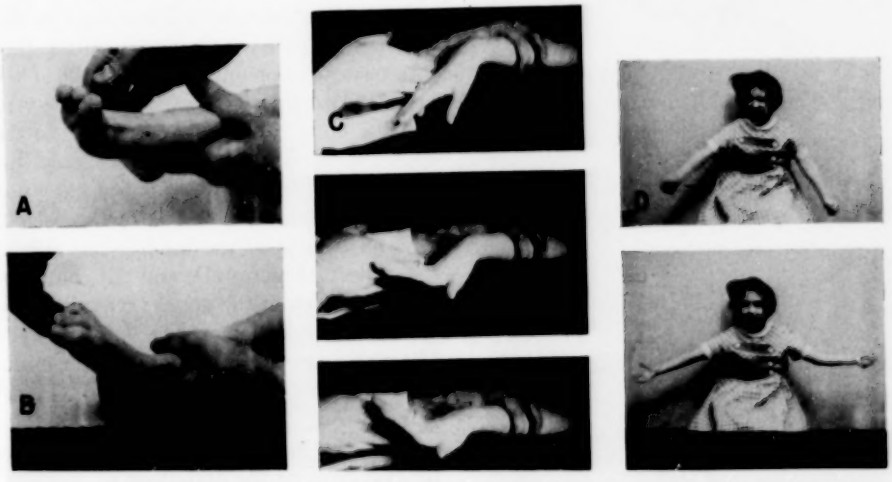

FIG. 5. A: extension of toes following contact stimulation of outer border of foot. B: flexion of toes on contact stimulation of medial sole. C: extension of fingers and wrist following contact stimulation of ulnar border of hand. D: extension and abduction of arms following sudden, unexpected noise.

limbs. This consisted of abduction and external rotation of the shoulder, flexion of the elbow to 90° or less, and pronation or supination of the wrist, which was also occasionally slightly flexed. In general the fingers were flexed or extended to various degrees, that is, either strongly extended, or strongly flexed (so as to present a closed fist), or they lay somewhere in a position midway between these extremes, although flexion of the fingers was more prominent than extension. Athetoid postures of the hands occasionally were seen in the resting posture. The thumb might be extended in those instances where the fingers were strongly extended, but in general it showed rather a natural position, or was slightly more adducted and flexed than normal. The lower extremities did not reveal so striking a change in resting posture in the supine position, except in some very young children (Figure 6) in whom there was flexion and abduction of the hips and flexion of the knees. The ankles were somewhat dorsiflexed and inverted and the toes revealed no particular abnormality of position. In older children the legs revealed no particular change of posture, although there might be some inversion of feet.

FIG. 6. Supine resting posture in three and one-half year old child with bilateral athetosis.

This posture altered with the body in other positions. In a sitting or standing position there was slight flexion of elbow and slight external rotation and abduction of the shoulder. The athetoid posture of the hand was more likely to be seen with the child in the sitting or standing position than in the lying position. The prone resting posture was generally similar to the supine with less postural resistance in the extremities.

TONIC-NECK REFLEXES

Tonic-neck reflexes were remarkably facile (Figure 7). Actual change in the posture of the limbs induced by these reflexes was far more striking in the upper extremities than in the lower. These changes could be induced by passive movement of the patient's head in relation to the body effected by the examiner, but with far greater facility by active movement of the head on the part of the patient. Changes in limb posture occurred not only with turning of the head to the side, but also with dorsal or ventral flexion of the head in relation to the body. Thus, there occurred not only the well-known "fencer's posture" of extension of the face limb and flexion of the occiput limb on turning of the head to one side or the other, (Figure 7D and E) but also marked flexion of the upper extremities following ventroflexion of the head (Figure 7B) and extension of the upper extremities following dorsiflexion of the head (Figure 7C). Strong ventroflexion markedly increased the peculiar spine resting posture by exaggerating the abduction of shoulders and flexion of the elbows and wrist. There was also some protraction of the shoulders with this maneuver. Strong dorsiflexion

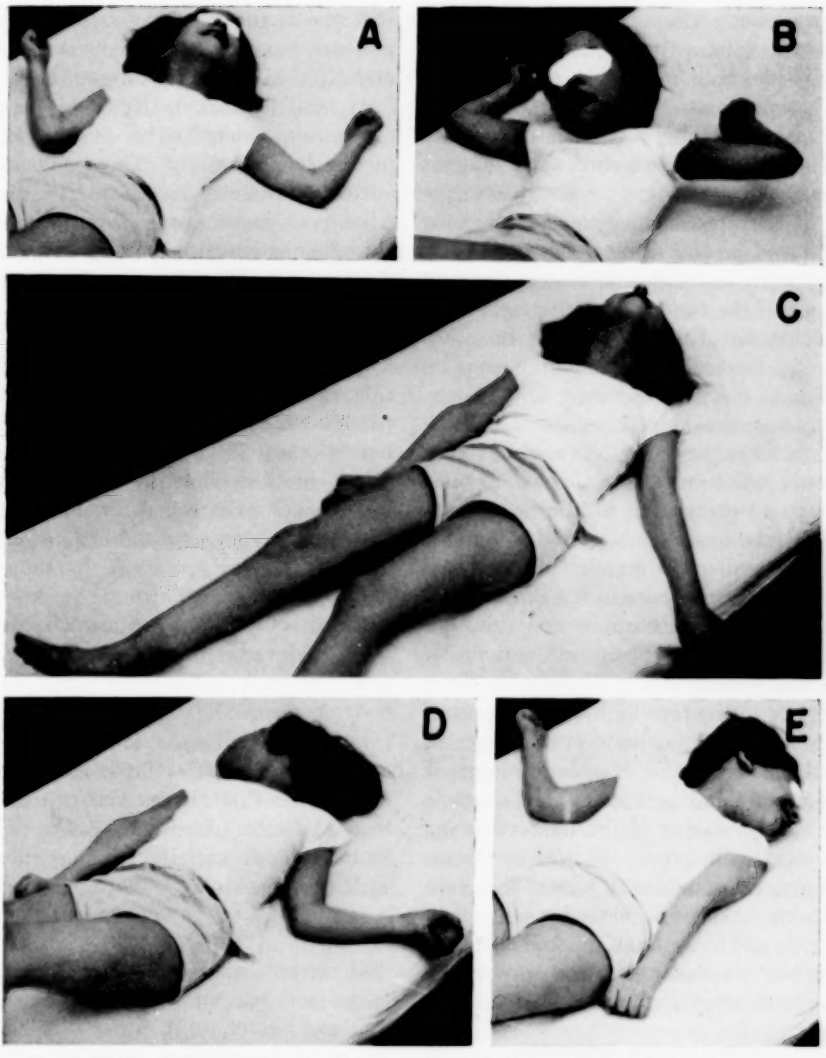

FIG. 7. Resting posture in A and effect of tonic-neck reflex in altering limb posture.

caused some adduction and retraction of the shoulders in addition to extension of the arms. In a sitting or standing position there was a greater latency for the flexion response on ventroflexion of the head, possibly related to the necessity for overcoming the force of gravity. However, it did obtain after several seconds. In the sitting position or the standing position the protraction or retraction of the shoulders was more prominent than in the supine.

Movements of the lower extremities were less prominent than in the upper extremities. However, in several patients, ventroflexion of the head, causing flexion of the upper extremities, also caused extension of the lower extremities, while dorsiflexion of the head caused flexion of the lower ex-

tremities along with extension of the upper extremities, and with movement of the head to the side, both face limbs would extend and occiput limbs flex.

The changes in limb position in response to tonic-neck reflexes varied with different patients. Most prominent was the assumption of the "fencer's position" on turning the head to one side or the other. Changes in limb posture in relation to ventral and dorsiflexion of the head were less striking and could not be demonstrated well in a few patients. Regardless of actual change in position of the limb, however, it was obvious that tonic-neck reflexes operated in all patients as evidenced by changes in resistance to passive movement of the muscles in response to changes in the posture of the head in relation to the body. Thus, by passively palpating the muscles of the limbs, or comparing resistance in the limbs as the patient turned his head to one side, one could detect an increase in extensor resistance and corresponding decrease in flexor resistance in the face limb and an opposite effect in the occiput limb, even though no actual movement of the limb occurred. Changes in limb position and changes in muscular resistance of the limbs were far more evident in proximal joints of the extremities than in distal joints, therefore, producing changes in shoulder and elbow and knee and hip without marked change in posture or resistance to passive movement in the muscles of the hands and feet.

LABYRINTHINE RESPONSES

Labyrinthine responses acting on the limbs, although present, were usually less easily demonstrated than the tonic-neck reflexes. In general, when the patient was held in the air all limbs extended, particularly when lowered quickly, revealing the "Sprungbereitschaft" of Magnus. When the body of the patient was held in the vertical plane with head up, and moved in a rotary direction, little change in limb posture was detected.

A remarkable response obtained in some patients was one of marked extension and abduction of the upper extremities particularly, and to a lesser degree of the lower extremities, elicited by a quick movement of the head dorsally. This response was variably obtained in many patients and when most facile caused wide extension of the upper extremities at the elbows, and abduction at the shoulders associated with extension and abduction of the fingers. This extension and abduction was then followed by some slight flexion at elbow and adduction at shoulder at the conclusion of the passive head movements in a few patients, but in others only the extension-abduction phase obtained. That this response was not a tonic-neck reflex was determined by making sure that the head did not move in relation to the body, that is, by supporting head and trunk so that both quickly tilted backwards together. If prior to effecting the quick backward movement the head was not in a strict anterior posterior plane with the body, but was slightly turned to one side, the extension and abduction of the arms was asymmetrical, the face limb extending more than the occiput limb. The resting state then after the transient movement of the limbs revealed a partial asymmetric tonic-neck reflex attitude.

RIGHTING REFLEXES

If the patients in this series were blindfolded and held upside down by the ankles the head righted itself, either by ventroflexion or by dorsiflexion, revealing operation of the labyrinthine righting reflex. This head movement was most often accompanied by variable degrees of similar movement in the upper trunk.

Demonstration of other righting reflexes in these patients was evident in their attempt to change from the supine to the prone position, in which instance a sequence of movements involving head, trunk and limbs occurred. Thus, the head first turned to a side followed by shoulders, trunk and

pelvis. When the patient was about half way over on one side the lower extremities extended, while the upper extremities flexed. With rhythmic alternation of flexion and extension of the extremities the patient finally was able to get to a prone position, at which time the head righted followed by elevation of the upper trunk by leaning on elbows and finally erecting the trunk by extending the arms and placing the hands palm down on the floor. The hind quarters were erected by acute flexion at hips and knees and finally the patient was able to get up on all fours and crawl about the floor. If patients were able to sit it was noticed that they did so generally by first rolling over from the supine to prone, and then sitting up in an infantile manner by extension of upper limbs. A few patients were able to change from supine to sitting without the necessity of a complete 180° roll to the prone, turning only half way, then extending the upper limbs to push the upper part of the body to a sitting position.

As noted above if these patients were placed on one side, the "thalamic posture" obtained, particularly in the upper extremities. This posture consisted of extension of the underlying limbs and flexion of upperlying limbs. The upperlying limbs also revealed strong adduction at the shoulder and hip along with flexion of the other joints of the limbs. In the upperlying arm marked flexion of the wrist was particularly striking. The fingers might be flexed or extended in this posture and generally, as the individual was not at complete rest in such a posture, exhibited the typical movements of athetosis. With the patient in this position, if one pulled on the upward lying arm, so as to passively stretch the shoulder adductors, increased flexion of all joints occurred, thus revealing the presence of the "traction response" (33).

RESISTANCE TO PASSIVE MOVEMENT

As stated above, none of the patients we have chosen for analysis exhibited any resistance to passive movement having the recognized qualities of spasticity, nor did they exhibit exaggerated deep tendon reflexes, or a true Babinski sign. It was clear, however, that there were differences in resistance to passive movement as compared with normal individuals. If one attempted to manipulate the patient's upper extremity while holding on to his hand one could encounter an intense resistance to passive movement of that limb to both flexion and extension, particularly in the distal muscles. This resistance was different from spasticity and different from extra-pyramidal rigidity. It was of rather greater intensity than generally encountered with either of these conditions. When present the distal segments of the extremities, that is, the fingers and wrist tended to assume fixed postures which could be displaced only with difficulty and which tended to re-assert themselves immediately at the conclusion of passive movement. This intense resistance to passive movement was also striking at a time of spontaneous "athetoid posturing" or during a period of athetosis. If, however, the observer grasped the patient's lower arm and shook it, this resistance was not apparent and the wrist and fingers were actually remarkably flaccid. On the other hand, even with this method of examination it was apparent that there was some increased resistance in the proximal segments. This resistance, however, was different and had a plastic quality. It was variably present in both flexors and extensors, adductors and abductors. It was markedly influenced by the tonic-neck reflexes, labyrinthine responses, and righting reflexes, particularly the latter with an increase or decrease of resistance corresponding to the postural effect on these muscles as altered by these responses.

CONTACTUAL RESPONSES OF THE HANDS, FEET, AND LIPS

Contactual stimulation to certain parts of the hands, feet and lips could also cause

changes of posture in these parts, either as flexion or extension of fingers and toes, or pursing or parting of the lips.

Extension and abduction of the fingers could be easily elicited by adequate contact stimulation to certain parts of the hand. This response could be most easily obtained by a distally moving contactual stimulus over the dorsum of the hand and on to the fingers, which would provoke extension and abduction of the fingers frequently associated with extension and abduction of the thumb (Figure 8B). The movement itself did not occur immediately during the initial phase of the stimulus, although a certain tightening of the extensor tendons could be shown, with actual movement of the fingers beginning toward the end of stimulation. The finger extension might continue for one to two seconds after cessation of stimulation. Continued stimulation could intensify this posture. The receptive field for this response included not only the dorsum of hand and all fingers and thumb, but extended down over the ulnar side of the hand and ulnar half of the palm on to the palmar surface of the ring and little fingers and also included the entire tips of the other fingers also. In a few patients, however, the receptive field for extension of fingers included practically the entire palmar surface of the hands and fingers. The response could be

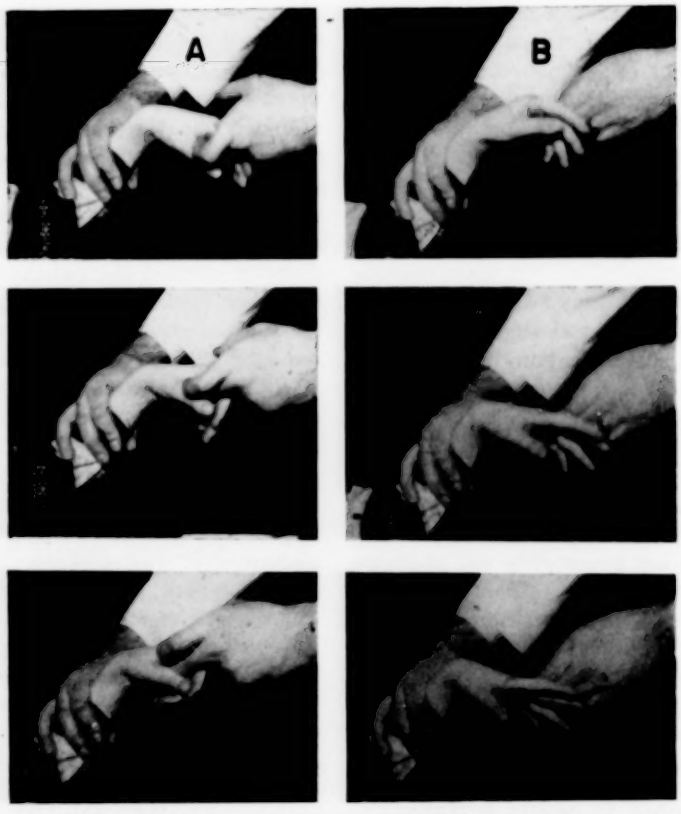

FIG. 8. A: flexion and adduction of fingers following contact stimulation of medial palm. B: extension and abduction of fingers following contact stimulation of dorsal surface of fingers.

fractionated in some patients, so that a distally moving contactual stimulus over one digit provoked extension of that digit alone, occasionally associated with slight extension of a neighboring digit. When the response was well developed contactual stimulation over the dorsum of all the fingers also provoked some dorsiflexion of the hand, or it might provoke or intensify the athetoid posture of the hand, extension and abduction of fingers and flexion of the wrist (Figure 5C). Contact stimulus over the ulnar aspect of the hand on to the little finger could also provoke ulnar deviation and pronation of the hand.

A flexor response of the fingers could also be obtained by contact stimulus to other parts of the hand. Thus, a contact stimulus (the examiner's index and middle fingers) to the medial aspect of the palmar surface of the hand moving out between the thumb and index finger provoked flexion and adduction of the fingers and thumb (Figure 8A). This flexion and adduction was intensified as the examiner attempted to withdraw his own fingers from the patient's "grasp." Frequently, however, one obtained only a fragment of this response, consisting of flexion of the index finger, particularly at the metacarpophalangeal joint, slight flexion of the middle finger at the same joint, and flexion and adduction of the thumb. Flexion of the thumb occurred then also at the metacarpophalangeal joint, the interphalangeal joints remaining partially extended. One could also obtain a flexor response by utilizing the usual stimulus for the grasp reflex, that is, a deeply pressing contact stimulus, moving out distally from the medial palm on to the fingers. This method required a stronger and deeper pressure than the other, but would induce again a sudden flexion and adduction of the fingers which could be sustained as long as the examiner maintained traction on them taking care not to touch the fingertips. Flexion and adduction of fingers might also be accompanied by some dorsiflexion of the wrist and supination of the hand, the latter especially when the response was evoked by stimulation between the thumb and index finger. Contact stimulation moving distally along the palmar surface of a single digit could induce flexion of that digit alone. The receptive field for this flexion response involved the medial aspect of the palm and the proximal palmar aspects of the thumb and other fingers, exclusive of the tips. A sudden flexion of the fingers might obtain as the stimulus moved on to the proximal phalanges, but would give way to a strong extension and abduction if the stimulus moved out on to the fingertips, which were in the receptive field for the extension response.

An interesting phenomenon was seen in one patient and fragmentary examples of this in other patients in which contactual stimulation of the palmar surface in the region of the third metacarpophalangeal joint could cause a succession of alternating flexion and extension movements of the fingers, clearly the phenomenon of athetosis (Figure 9).

Similar flexion and extension responses were also obtained in the feet of some of these patients by contactual stimulation. Thus, a light contact stimulus, but never of heavy quality (as used to elicit the Babinski response) could cause movements of flexion or extension of the toes. A distally moving contactual stimulus along the outer border of the foot caused extension and abduction of the toes, abduction and slight extension of the great toe being particularly prominent (Figure 5A). The receptive field for this response also involved the lateral half of the sole of the foot and the dorsal aspects of the foot and toes. A distally moving contactual stimulus along the medial side or sole of the foot, however, would cause flexion and adduction of the toes (Figure 5B). Many of the patients revealed only an extension and abduction response of the toes, and in these the receptive field for this response involved the entire plantar surface

FIG. 9. Alternating flexion and extension of fingers on stimulation of palm in region of third metacarpo-phalangeal joint.

of the foot, both medial and lateral aspects. Inversion or eversion of the foot accompanied flexion or extension of the toes, but was not a constant feature.

The patients who revealed both flexion and extension responses of the toes from contact stimulation also revealed occasional spontaneous athetosis of the toes. Those who had only extension responses did not exhibit spontaneous athetosis.

It was interesting that a light contactual stimulus would result in extension of all the toes, particularly extension and abduction of the great toe, while in the same patient a stronger stimulus, such as used to elicit the Babinski response, produced instead a flexor plantar response from the same region of the foot. Light contactual stimulation of the foot in many patients resulted not only in extension and abduction of the toes, but also in marked flexion of the entire lower extremity. This marked flexor response might occur with the lightest of contact stimuli and it was clearly possible to show that this was not voluntary withdrawal. In these patients again a flexor response of the entire extremity, associated with an extension of the toes, would not occur with a stronger stimulus, as used for a Babinski response.

Contact stimulation of the lips also provoked certain opposite responses. Thus, a contact stimulus over the upper lip moving downward along the midline of the lip caused variable degrees of pursing of the lips which could outlast the stimulus by as much as one and one-half seconds (Figure 10A). Stimulation moving from the lateral aspect medially on the lower lip might cause either slight retraction of the lips, or more frequently parting of the lips (Figure 10B). We have not been able to demonstrate movements of the tongue with these stimuli and have noted both protrusion and retraction with either pursing or parting of the lips.

Care was taken in all these patients to

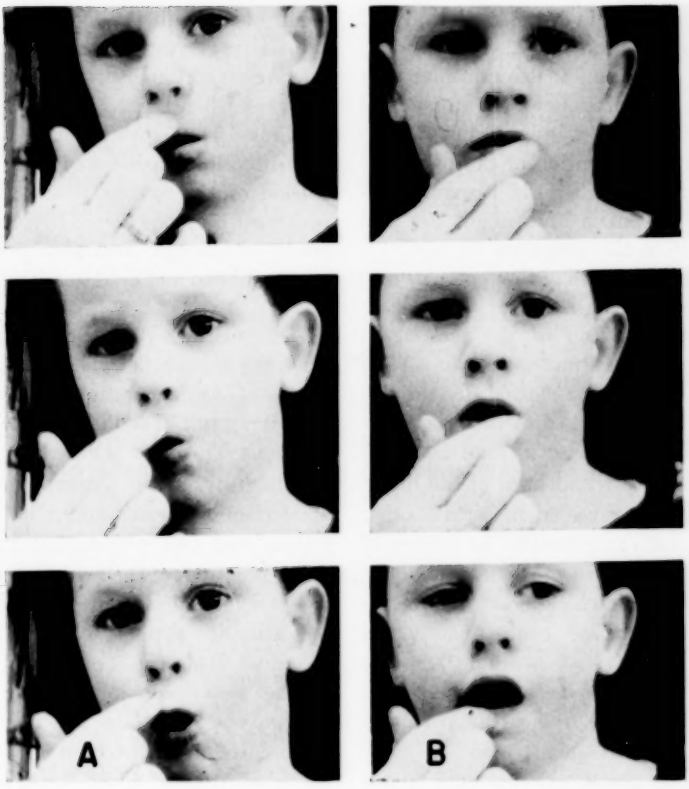

FIG. 10. A: pursing of lips following contact stimulation of upper lip. B: parting of lips following contact stimulation of lower lip.

be certain that the contact stimuli were delivered during a quiescent period and not during phases of spontaneous athetosis. These responses could be elicited consistently, and were not necessarily followed by spontaneous athetotic movements with the patient relaxed.

DISCUSSION

THE NATURE OF ATHETOSIS

It was apparent that the flexion and extension postures of the fingers and toes and the antagonistic movements of the lips evoked by contactual stimulation of these parts were opposite reactions which, in alternation, constitute athetosis.

The over-extension and abduction of the fingers frequently associated with some extension and pronation of the wrist as the hand approached to grasp an object (Figure 2B) and which could also be elicited by appropriate contact stimulation of the hand (Figures 5C and 8B) was identical in form to a withdrawal reaction called the "avoiding response" by Denny-Brown (6, 7), frequently seen in the clinic in the limb opposite to a parietal lobe lesion. In such instances the same form of response is encountered as the hand is extended toward an object, and may also be elicited by certain contactual stimulation to the palm or dorsum of the hand (tactile avoiding response) or it may appear in response to a visual stimulus in the opposite visual field (visual avoiding response). Denny-Brown

and Chambers (8) in a detailed study of parietal lobe function in man and in monkeys have pointed out that oftentimes very light tactile stimulation of the dorsum of the hand of a monkey might elicit *flexion* of the wrist and extension or flexion of the fingers, and that when the response was very facile the entire limb might flex and fold away from the stimulus.

An avoiding response of the foot may also occur, in general consisting of marked extension and abduction of the toes again elicited by contact stimulus to the sole of the foot. Occasionally flexion of the leg away from the stimulus may also occur.

The avoiding response in man need not be limited only to withdrawal of the limbs, but may also be revealed in certain other movements, such as retraction or parting of the lips and adversive movements of head and eyes, reactions which again may be induced by appropriate contact or visual stimuli. In monkeys an avoiding response of such intensity as to cause a turning from or withdrawal of the whole animal from a stimulus has been demonstrated.

The opposite posture of athetosis on the other hand, the flexion of fingers (Figure 8A), sometimes associated with some extension of wrist, is clearly related to the grasp reflex as described by Seyffarth and Denny-Brown (30). This response consists of a quick flexion and adduction of the fingers (catching phase) induced by a distally moving contact stimulus to the palm, which can then be sustained by resistance against the flexed fingers (proprioceptive holding phase). Seyffarth and Denny-Brown pointed out that the receptive field for the grasp reflex occupied the medial aspect of the palm and the proximal palmar surfaces of the fingers. They also showed that the response could be fractionated so that contact stimulus to one finger alone could induce flexion of that finger only.

In the clinic the grasp reflex is frequently seen in the limbs opposite to a lesion of the frontal lobe. Not only may it occur in the hand, but also in the foot as a response to a distally moving contact stimulus to the sole. Again certain other movements may be observed when reflex grasping is present in the limbs. Thus, for example, pursing of the lips oftentimes associated with some protrusion of the tongue (instinctive sucking response) may be elicited by contact stimulation of the lips, and also pursuit movements of head and eyes to appropriate stimuli.

Denny-Brown (6, 7) has pointed out that when the grasp reflex and avoiding response are in unstable equilibrium, athetosis occurs as a result of conflict between these two reactions. This view is clearly substantiated in this study. In our patients the extension-abduction and flexion-adduction postures of fingers and toes represented the identical motor reactions of the avoiding response and grasp reflex, elicited by the adequate contact stimulus applied to the corresponding receptive fields for these reactions. In like manner we are convinced that the alternating movements of the lips in our patients represented a conflict between two opposite reactions, each of which could also be elicited by appropriate contact stimulation. The peculiar alterations of posture of the head and eyes frequently encountered must result in like manner from a conflict between the tactile and visual mechanisms for adversion and pursuit movements of head and eyes.

Both the grasp reflex and avoiding response could be fractionated in some of our patients so that flexion or extension of a single digit could be obtained by contact stimulation to the palmar or dorsal aspect of that digit alone. This fractionation of both responses is no doubt significant and may provide explanation for the peculiar phenomenon of athetosis in which one finger may extend while its neighbor flexes.

Contact stimulation of the dorsum of the hand could elicit not only extension and abduction of the fingers, but might also cause some flexion of the wrist, thus result-

ing in the athetoid hand. In like manner elicitation of the grasp reflex not only caused flexion of the fingers, but occasionally a synergistic extension of the wrist.

We also noted that upon elicitation of the avoiding response some pronation of the hand often occurred, while with the grasp reflex supination obtained suggesting that the pronation and supination frequently accompanying the flexion and extension of fingers in athetosis may also be related to a mechanism for orientation of the hand by contact stimulus.

THE DEFICIT IN VOLUNTARY MOVEMENT

It has been clear from these studies that not only were the alternating movements characteristic of athetosis related to a conflict of the avoiding response or the grasp reflex, but that these responses also contributed to the deficit in voluntary movement. In our patients all reactions were biased toward withdrawal responses and therefore the avoiding response contributed more to the deficit in voluntary movement than the grasp reflex. This was particularly evident when the patient attempted to grasp an object, in which instance the fingers extended and abducted widely (Figure 2B) often seeming to extend and abduct more as the patient tried harder to get the object. This ataxia of the limb as the hand approached an object was identical to that which we have described previously in infantile spastic hemiparesis (34), and also showed to be related to over-activity of the avoiding response. Over-activity of the avoiding response could cause the patient to drop an object once it had been picked up, or cause the fingers to fly apart as they were attempting to close about an object (Figure 3). In some patients over-activity of the avoiding response was not only prominent in causing extension and abduction of fingers, but might also cause a movement of the entire head and upper trunk away from the object sought for.

It was also clear that exaggeration of the opposite response could cause difficulty in use of the hand, although less frequently. Thus, the hand might spontaneously close if it happened to strike an object in the receptive field of the grasp reflex, or in some patients the hand seemed to remain tonically closed around an object and would close even tighter if one attempted to remove the object. Again as some patients attempted to bring the hand close to an object the hand remained tonically closed, only to fly open suddenly and withdraw as the hand contacted the object in the receptive field for the avoiding response (Figure 4).

The over-flexion and abduction of the legs and a tendency to fall backward in those patients able to walk correlated with over-activity of the avoiding response in the feet. This "peacock gait" was also evident in our patients who were unable to walk alone, but who could take steps with assistance.

Clement and Twitchell (3) have recently analyzed the speech deficit in patients with bilateral athetosis and have suggested that the conflicting responses not only affect the peripheral speech mechanisms involving lips and tongue, but may also contribute to certain other defects of articulation involving pharyngeal and laryngeal structures. The bias toward avoiding is again evident as attempts to produce labial sounds are most often preceded by a parting of the lips.

These disorders of movement are identical in form and physiologic nature to the type of kinetic apraxia recently discussed by Denny-Brown (7) as "repellent apraxia" associated with exaggerated avoiding responses and "magnetic apraxia" associated with exaggerated reflex grasping responses. Some of these responses have also been described by others, but without a clear definition of their physiologic nature.

Thus, both Foerster (11) and Herz (19) have commented on a tonic closure of the fist in patients with bilateral athetosis which could only be released with difficulty. Foerster noted that the patient himself learned to release this tonic grasp by stimulation of

the dorsum of the hand and fingers, which phenomenon has also been discussed by Denny-Brown (7) who has related the release of this tonic grasp to the elicitation of a slight avoiding response by stimulation of the dorsum of the hand. Foerster (11) commented on the ability of a patient to overcome a flexion spasm of the wrist by touching the palm, and noted that a light passive flexion of the fingers would release it. Perhaps here contact might initiate a grasp reflex reciprocally relaxing the wrist flexors and inducing contraction of the extensors of the wrist as a synergy of the grasp reflex. Foerster also described the initiating of a grasp by placing his fingers in the patient's palm, and of initiating rhythmic licking, sucking, chewing and swallowing movements by placing his finger in the patient's mouth. He noted that a contact stimulus in and around the region of the feet could initiate either extension or flexion of the toes, and indeed was able to initiate an embracing phenomenon of the whole arm or leg with appropriate contact stimulation. The Vogts (37) obtained a "pseudo-Babinski sign" (extension of the great toe) by peripheral stimulation, yet noted interestingly that this response was not constant with the usual type of stimulus for the Babinski sign.

Although these abnormal and persistent reflex reactions accounted for considerable deficit in voluntary movements, the facile neck and labyrinthine reflexes also contributed significantly to this deficit. This was particularly striking in the difficulty these patients had in extending the arm to reach for an object. Thus, one of our patients with extremely facile avoiding responses actually turned his head and eyes and upper trunk away from the object when attempting to reach for it. A strong abduction of the shoulder and flexion of the elbow then occurred, so that the arm adopted a posture similar to that in the supine resting position, and clearly related to the tonic-neck reflex. Although most patients did not turn the head and eyes away from an object, they did characteristically ventroflex the head and often the upper trunk in order to get closer to an object, in which cases the tonic-neck reflex again caused increased flexion of the upper limbs. In the patient shown in Figure 1, the ventroflexion of the head was a constant feature as she attempted to reach for an object. With this ventroflexion there was strong abduction of the shoulder and flexion of the elbow with extension and abduction of the fingers which might alternate with flexion of the fingers as "athetosis." (A slight turn of the face to the left has actually induced an asymmetric tonic-neck reflex posture in this patient as shown in Figure 1). For several seconds a coarse tremor of the upper limb might ensue before the difficulty in flexion was finally overcome and the arm extended in a wild, ataxic manner toward the object. This difficulty could be overcome, however, if the object was placed to the side of the arm to be used, and if the patient was instructed to look at the object before reaching for it. In this manner the effect of the tonic-neck reflex was to facilitate extension of the arm, enabling a more efficient reach.

Difficulty in voluntary adduction of the limbs correlated with persistence of the overactive labyrinthine response causing abduction of the limbs described earlier. For example, as one patient attempted to reach for an object placed in front of her, the limbs would abduct at the side, so that she would have to twist the entire trunk around in order to get her hand to the object. This patient had a particularly facile kinetic labyrinthine response, and consequently the greatest difficulty in voluntary adduction. Other patients with less facile labyrinthine responses, had corresponding difficulty in adduction although not as marked as in this particular patient. Interestingly, if the examiner lightly placed his hands on the dorsal surface of the patient's hands, the hands could be folded around in close to the trunk, so as to approximate very easily, showing that facilitation of the avoiding response

could overcome the labyrinthine response. In this regard it is interesting to note that Denny-Brown and Chambers (8) noted similar spontaneous infolding of the limbs following section of both eighth nerves in monkeys with bilateral parietal lobe lesion. Patients in whom the labyrinthine response could not be demonstrated had no difficulty in adduction.

Certain factors contributing to the apparent muscular "weakness" were clear from this study. Thus, the ability to maintain a grip of the fingers was inversely proportional to the facility of the avoiding response and area of its receptive field. An object therefore could be grasped with greater strength and facility from the medial aspect of the palm and proximal phalanges, thus utilizing the grasp reflex mechanism to facilitate voluntary grasping. It was consequently most difficult, if not impossible, to grasp an object from the ulnar side of the palm, for such would immediately initiate antagonistic avoiding.

Inability to integrate reflexes further contributed to weakness of grasp for there was a common tendency for the wrist to flex along with the flexion of the fingers. If the patient increased the power of the grip, a flexion synergy involving all joints of the upper extremity ensued. We have related this flexion synergy to the presence of the traction response with which it is identical in form (33, 34). The mechanical disadvantage of wrist flexion to finger flexion and its obvious effect on power of grasp has been discussed by us previously (34). We pointed out above that the grasp reflex was often associated with synergistic wrist extension similar to that in the normal voluntary grasp. Many of our patients did reveal synergistic extension of the wrist as the fingers flexed as part of a reflex induced grasp. If these same patients were able to grasp an object lightly, from the medial palm, the wrist extended synergistically. As power of grip was intensified, however, the extension of the wrist could give way to flexion, showing a prepotent effect of the traction response with increase of willed effort.

ASSOCIATED MOVEMENTS AND MASS MOVEMENTS

The so-called associated movements and mass movements were clearly related to neck and labyrinthine reflexes. Associated movements might mirror the willed movement of an opposite limb or be reciprocal to it, and in general corresponded to the movement synergies described by Foerster (11) and identical movement patterns could be produced by movement of the head in relation to the trunk (tonic-neck reflex). We have commented earlier on the common tendency for the patient to move the head in any voluntary effort, and refer again to Figure 1 where an associated reaction in the left arm and its relationship to the neck reflex mechanism is apparent. We are therefore in agreement with Walshe (39) who pointed out that associated movements were not actually movements, but rather were postural reactions allied to the tonic-neck and labyrinthine reflexes of Magnus with which they could combine and interact. In the hemiplegic these responses could best be elicited by tonic voluntary activity of the normal limb inducing Walshe to describe the associated reactions as "tonic reflexes arising in the limbs and acting on the limbs."

Associated movements and mass movements are physiologically related. Reciprocal associated movements would seem more related to asymmetrical neck reflex postures, and similar associated movements to symmetrical neck reflex patterns (bilateral flexion and extension of limbs associated with dorsal or ventral flexion of the head). Associated movements have generally been considered to involve only one other limb than the one being voluntarily moved, although more limbs certainly may take part in associated reactions. Associated movements are generally slower movements than mass movements, possessing a more "tonic"

quality, although again this cannot serve as an absolute point of distinction.

Mass movements involve all the extremities and frequently the head and trunk. Mass movements were not frequently seen in our patients and occurred only in those patients who exhibited the kinetic labyrinthine response, and then took the same form with extension and abduction of the limbs. They often occurred as part of a startle reaction to any sudden unexpected stimulus (Figure 5D). They were also frequently observed as these patients attempted to maintain balance either in the sitting or standing positions. In such instances with the sudden movements of the head and body, particularly in a backward direction the limbs would extend and abduct strongly. This wild brief phasic movement could often cause the patient to lose his balance, a similar difficulty having been noted by Koven and Lamm (23) and related by them to persistence of the infantile Moro response in patients with bilateral athetosis.

RESISTANCE TO PASSIVE MOVEMENT

The postural resistance in the limbs of patients with athetosis has been often discussed. Hammond (18) noted intense rigidity during spontaneous athetotic movements as did Foerster (11), Wilson (40) and others. Foerster and Wilson stated, however, that when the spontaneous movements were absent the limbs revealed no increased resistance to passive movement and indeed might be "hypotonic."

We have also observed an intense rigidity of the distal limb segments during spontaneous athetosis or at times when the fingers and wrist remained "fixed" in either of the extremes of the antagonistic postures. We also found that intense rigidity of these parts might occur when passive movements of the extremity were made with the examiner holding the patient's hand. The arm, however, might be quite loose if the limb was held by the forearm and manipulated in this manner. We feel sure, therefore, that the contact reactions of the hand were responsible not only for the athetotic movements, but also for this apparent rigidity occurring at certain times.

On the other hand we also encountered a different and more constant form of resistance to passive movement in the proximal limb segments which was present with the patients at complete rest. This resistance had a more plastic quality, and although present in both flexors and extensors, might be more intense in flexors at one time and in extensors at another. This resistance was not so markedly influenced by the contact reactions of the hand. It was, however, greatly increased or decreased by tonic-neck, labyrinthine and righting reflexes, the resistance in flexors or extensors being increased or depressed corresponding to the effect of these reactions, suggesting that proximal resistance is related to these exaggerated responses.

Earlier studies of athetosis have been oriented perhaps more towards an anatomical explanation than physiological. Thus, both the Vogts (37) and Jakob (22), for example, emphasized that the disorder was a result of dysfunction of the striatum, allowing the release of pallidal effects.

A physiological interpretation has been provided recently in a series of papers by Denny-Brown (5, 6, 7), who has shown that in the cerebral cortex regions subserving both positive exploratory reactions and negative withdrawal reactions can be separated out. Positive reactions are the instinctive grasping and groping responses, and negative are the instinctive avoiding responses. These reactions can all be initiated by adequate stimuli, either contactual or visual and normally are in equilibrium with each other. A lesion abolishing one response will release its opposite (transcortical release). The cortical responses also have subcortical analogues of less refined response which require coarser stimuli and lesions in subcortical regions cause more "tonic" effects. Chorea, athetosis and tremor are the result o

an unstable equilibrium or conflict between these positive and negative reactions at different levels of the central nervous system.

We have shown that a major factor contributing to the motor deficit in bilateral athetosis is the difficulty in suppressing these antagonistic responses, and the continued exaggeration of neck, labyrinthine and righting reflexes which oftentimes themselves are mutually antagonistic to one another. We do not imply as others have that these responses should have "disappeared" during the course of normal neural maturation, for their presence in normal adults may still be revealed. Thus, the elements of the grasp reflex and avoiding response may both be demonstrated in normal individuals (7). Operation of the righting reactions is clearly evident in normal behavior and Ikai (21) has been able to demonstrate the tonic-neck reflex in normal adults. In patients with bilateral athetosis, however, these responses have in some manner not become integrated to allow for normal voluntary movement.

RELATION TO MOTOR RESPONSES IN INFANTS

The similarity of many of the responses in patients with bilateral athetosis to those of normal human infants has been noted by others. The Vogts (37) attributed it to the lack of myelination of the striatum up to five months of post-natal age. Freud (12) felt that chorea and athetosis in older individuals occurred not so much as new symptoms, but rather as symptoms remaining from, or a return to a more infantile stage. Foerster (11) commented that the "athetotic movements" and the mass movements of the infant, the supine resting posture, and the "Hockerstellung" in the prone position were similar to those phenomena in patients with double athetosis. Peiper (28) has more recently commented on the similarity of normal infantile motor function to that in patients with bilateral athetosis. Our own studies of infantile motor function have only begun, but they do indicate that movements and movement mechanisms in the normal human infant are not only similar to those mechanisms in the patient with bilateral athetosis, but are indeed identical.

The resting posture of upper and lower extremities of the infant in the supine position takes the identical form to that of the younger child with bilateral athetosis, (Figure 6) and this posture in the upper extremities persists in older children and even some adults with bilateral athetosis. In both infants and patients with bilateral athetosis the resting posture is markedly determined by the tonic-neck reflex.

The response of the infant to a loud noise, a sudden flash of light, or a jar to the bed, etc., that is, the Moro reflex is identical to a startle response in many of our patients and is generally of identical form to the mass movements illustrated by Foerster (11). It is said to be present in slightly over 30 per cent of the patients with athetosis by Koven and Lamm (23) and both Moro (27) and Freudenberg (13) noted a persistence of the Moro reflex in infants with cerebral disorder and certainly a two year old in Moro's series probably represented double athetosis. McGraw (25) has described the form of the Moro reflex in the infant as consisting of bilateral extension and abduction of the upper extremities with wide spreading of the digits, ending in a bowing over the thorax before the supine resting posture is resumed. This response is accompanied by extension of the spine and often a retraction of the head. The legs may flex slightly and then extend. At two to three months the bowing of the arms and extension of the spine are reduced until finally the body remains flat and the arms extend and abduct only, as Homburger (20) also showed. In later infancy the response takes the form of only a jerk. Freudenberg, (13) however, pointed out that adduction of the arms may not ever obtain in the very young infant, so that only extension and abduction occur.

Freudenberg (13), Schaltenbrand (29) and Peiper (28) have suggested that the Moro reflex is a kinetic labyrinthine reflex,

and could be easily elicited by a quick backward tilt of the infant. Our own studies support this view. That it may occur in the infant as a response to other "stimuli" indicates only that it is one of the few positive motor reactions available at an early stage and thus constitutes a large segment of infantile motor behavior.

It is no doubt important that the facility for elicitation of this response in the infant declines as the ability to adduct the limbs purposively is acquired. In this regard we believe it is significant that our patients with bilateral athetosis who revealed an identical labyrinthine response had great difficulty with adduction of the limbs, while those with a less prominent labyrinthine response had less difficulty, and those with no such response had no difficulty in adduction of the limbs. The mass movements of the infant and the patient with bilateral athetosis are also identical. In the infant we would agree that these are also related to labyrinthine and neck reflexes as Peiper (28) has shown, just as they appear to be in patients with bilateral athetosis.

It has frequently been stated that the grasp reflex is present in the new-born and persists for a number of months thereafter. In our experience the response in the new-born is not the true grasp reflex as defined by Seyffarth and Denny-Brown (30), but rather is related physiologically to the traction response. This is also supported by the work of Halverson (16, 17), who noted that an outstanding feature of the infantile grasping response was strong wrist flexion or associated flexion of the wrist and elbow, and that the response was enhanced by a pull on the arm and also by Peiper's observations (28) that the response can be modified by postural reflexes. The true grasp reflex begins to make its appearance at a later time.

In the early weeks of life one obtains primarily withdrawal responses from contactual stimulation of the hands or feet. These responses are identical to the avoiding response as described earlier in this paper and consist of extension of the fingers, eventually associated also with abduction of the fingers, and of extension and abduction of the toes. In the hand this response can be obtained by a distally moving light contact stimulus to the dorsum of the hand and fingers, or to the outer side of the hand and the ulnar surface of palm, or by stimulation of the fingertips. This response is far more facile than the true grasp reflex in early infancy. It is identical to the response called the "digital extension reflex" by Spitz (32). He pointed out that the response usually began with extension of the index finger or of the little finger and then was followed by extension of the others and could occasionally be associated with strong dorsiflexion of the wrist. Halverson (16, 17), in his studies of infantile grasping responses, noted that with very light stimulation, one was more likely to obtain withdrawal of the hand in the early weeks of life, but that ease of obtaining withdrawal of the hand decreased with maturity.

Our own studies have shown that the true grasp reflex develops gradually and later than the avoiding response. It may first be obtained in the hand in fragmentary form at several weeks of age, and is then best elicited by a moving contact stimulus out between the thumb and index finger. The response at this stage consists of adduction of the index finger and thumb. It is no doubt significant that Seyffarth and Denny-Brown (30) showed that the grasp reflex consists of a combination of local reactions, of which the local reaction consisting of adduction of thumb and index finger obtained from a distally moving contact stimulus between thumb and index finger was the strongest. With continuing maturation of the infant the grasp reflex becomes more facile and at around three or four months of age one may obtain fairly consistently the total response by a distally moving contact stimulus on the palm out on to the fingers. It would appear that with maturity there is "extension"

of the receptive field for the grasp reflex so that a summation of local reactions may obtain to give the complete grasp reflex. It is clear, however, that as the fingertips are stimulated the response may give way to an avoiding reaction.

It is to be emphasized that these reactions do not develop in set stages, so that the avoiding response develops initially and is completely developed before the grasp reflex, but rather they develop hand in hand with early bias toward withdrawal responses. As others have pointed out the young infant shows primarily flexor responses. Extension and adduction come later on. However, although the avoiding response is more prominent early, its great facility lessens as the grasp reflex becomes more facile. Purposive use of the hand in the infant occurs concomitantly with increasing facility for the grasp reflex, but even at six or eight months when the hand is being used with considerably more dexterity the ataxia as the hand approaches an object and the widely extended and abducted fingers document the continued exaggeration of the avoiding response.

We have found that identical responses may be obtained in the feet of the infant, and again that the avoiding response obtains with more facility at an earlier age than the grasp reflex of the foot. The receptive field for the avoiding response is the outer border of the foot, or the dorsal surface, and at a very early age indeed stimulation over the entire plantar surface may produce extension and abduction. Somewhat later one can obtain flexion and adduction of the toes, particularly from stimulation of the medial aspect of the plantar surface of the foot. Some inversion or eversion of the foot may also obtain with these stimuli. As the avoiding response in the hand diminishes in intensity with corresponding increasing facility of the grasp reflex in the infant, so extensor plantar responses diminish as the flexor plantar responses become more facile. These findings are generally in accord with the work of Zador (42), Waggoner and Ferguson (38) and Dietrich (9). It is interesting that Waggoner and Ferguson noted that extensor plantar responses were more easily elicited with "weak" stimuli than with "strong" stimuli in young infants, recalling our similar experience in patients with bilateral athetosis.

It is clear that the normal infant possesses the mechanism for athetosis. At an early stage of development the identical mechanisms may permit a rather identical "disorder" of movement. For example, ataxia is considerable, eyes frequently are not fixed on the object reached for and, as McGraw (26) has also pointed out, when the infant first uses the hand to grasp he may approach ataxically and circumductively with fingers extended and abducted (avoiding) or may approach with a closed fist (grasping).

The details of the neural maturation of behavior in the human infant have yet to be carried out. We are not convinced that the maturation or development of normal movement in the infant is identical to the mechanism of recovery from acquired cerebral lesions in later life. We are sure, however, that these various simple mechanisms of the infant are not lost in the adult, but rather that they are combined and elaborated (integrated) into what is known as purposive behavior.

Some of these aspects of infantile motor development have been considered by Schaltenbrand (29). We have been particularly interested in his account of the body righting reaction in infants, for he noted, as did McGraw (26), that a young infant attempts to right himself in a manner identical to the quadruped by utilization of the righting reflexes of Magnus. The younger infant in the supine position might turn the head from side to side, but if he rolled over it was probably by "luck." In the second half of the first year of life the child turns more easily from supine to prone and Schaltenbrand noticed that first the head turned,

then the shoulders, then the pelvis, and then the whole body. In the prone position the head is erected, later the fore part of the body and finally the infant is able to get up on all fours. From the prone position the child first learns to sit by extending both arms and rotating his body to a sitting posture. At two or three years of age he can change from the supine to the sitting position by turning the pelvis to the side and extending one arm to push himself into a sitting position. Finally the child acquires a "mature" form of symmetrical sitting by simple flexion of the body in the anterior-posterior plane.

It is interesting that our patients utilized the infantile form of righting and sitting. We feel sure that there is not a defect in righting reflexes as some have maintained, but that these children utilize an infantile form of righting, perhaps never acquiring the "adult form."

Schaltenbrand also noticed that the tonic-neck reflex diminished in facility over the first two years. Interestingly, Peiper (28) points out that the infantile resting posture also alters during the first years, and we suspect that this resting posture is clearly related to the neck reflexes. Our patients with retention of the tonic-neck reflex continued to exhibit the infantile supine resting posture.

We have been impressed by a lack of "eye-hand coordination" in our patients. Patients with even normal intellect would not look at objects toward which they were reaching, reminiscent of the early reaching of infants (14, 15). Development of "eye-hand coordination" may be related to integration of groping and avoiding responses, but this aspect requires further investigation. Gesell and Amatruda (15) describe the early infantile reaching maneuvers and point out the frequency of bilateral limb activity, "mass movements" strikingly similar to those of patients with bilateral athetosis. Their descriptions of the evolution of purposive prehensile activity of the hand are also instructive for they point out that initially all the fingers flex around an object (ofttimes accompanied by flexion of the wrist). With continued development increasing dexterity of finger movement obtains with eventual acquisition of ability for more isolated finger-thumb apposition. Our own studies have been able to correlate this development with eventual integration of the instinctive grasping and avoiding responses as indicated also by Denny-Brown (7). In patients with bilateral athetosis as well as the infantile spastic syndromes (34) faulty integration of these responses is evident.

We have stated previously that certain differences in motor deficit occurred in different patients. Those differences were generally quantitative rather than qualitative. Older patients did not show abnormality of supine resting posture in the legs, and the oldest patient in our series revealed no abnormality of resting posture whatsoever, although previous records revealed that she had shown the abnormal resting posture six years earlier. In this respect, it is interesting that at the earlier time she had also revealed facile neck reflexes, while at the time of our examination they were difficult to demonstrate, the relationship of neck reflexes and supine posture being similar in this case to that in the infant. We have noted improvement in ability for willed adduction of the limbs concomitant with diminishing facility for the kinetic labyrinthine response, as occurs also in the normal infant. Eventually many patients learn to walk, feed and clothe themselves irrespective of any special form of therapy. Such observations indicate that congenital bilateral athetosis is not a static condition and that in some manner, maturation of motor function, delayed and imperfect in form, does indeed occur. Our limited observations indicate some similarity between maturation in these patients and the normal infant, although obviously much delayed and not identical. Elucidation of the nature

of this defective maturation awaits further longitudinal study of the physiological mechanisms of motor function in similar patients correlated with more detailed studies of normal motor development.

CONCLUSIONS

The phenomenon of athetosis is an instability of posture resulting from conflict between antagonistic motor reactions that are essentially reflex in nature. Thus, the alternating, periodic flexion and extension of fingers and toes or pursing and parting of the lips result from an unstable equilibrium between the grasp reflex and avoiding response. The postures may occur spontaneously or in response to their natural physiologic stimuli.

Purposive movement in patients with congenital bilateral athetosis is defective not only because there is an inability to suppress the antagonistic member of these two responses during a desired movement, but also because of concurrent interfering reactions, associated, and mass movements generally of neck and labyrinthine reflex origin.

Motor function in patients with congenital bilateral athetosis is "immature" in form and identical in nature to that of the normal human infant. This suggests that the motor deficit in congenital bilateral athetosis is physiologically related to failure of normal sensory-motor integration with a corresponding exaggeration or hypertrophy of infantile motor reactions.

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A METHODOLOGICAL STUDY OF FREUDIAN THEORY: II. THE LIBIDO THEORY

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The libido theory began with the assumption that the sexual constitution expressed itself through a sexual drive or instinct.[2] Freud assumed that all clinical phenomena were manifestations of this instinct and hence psychic energy was really sexual energy or libido. He postulated that it had a quantitative distribution and was discharged through several somatic channels in successive developmental stages from oral to anal to genital. It could undergo arrest in its development ("fixation"), could return to an earlier level of development ("regression"), and could be "desexualized" and find a non-sexual expression ("sublimation"). The libido theory thus described the vicissitudes of behavior in terms of the sexual instinct and its energic components.

Freud established a simple correlation between normality, perversion, and neurosis. Normality developed as a result of repression of the component instincts of the "polymorphous-perverse" infantile sexual disposition and their subordination under the primacy of the genital zone. Thus, in the normal adult, the libido was discharged through genital activity in heterosexual intercourse. In perversion, repression failed because of the constitutionally-determined "overpowering and compulsive development of certain of the component instincts." This resulted in a fixation of the libido which was then discharged directly through an extragenital erogenous zone. The perversion, therefore, was an undisguised expression of the infantile sexual wish. Neurosis, on the other hand, was the "negative" of perversion. "Unduly severe" repression of the component instincts in childhood prevented libidinal discharge at the pre-genital levels of development in the adult. The libido then sought an outlet through neurotic symptoms which were substitutes for the perverse sexual activities of childhood.

The libido theory served not only to define the stages of instinctual development, but also linked each stage with a specific sexual object. The first libidinal attachment was the maternal breast which through the feeding process provided oral-erotic gratification as well as nourishment. The second object-choice was an autoerotic one, the child's own body. Weaning forced him to seek libidinal pleasure through the successive component instincts and their associated erogenous zones: oral, anal-sadistic, and phallic. With the onset of infantile masturbation during the phallic stage the libido again sought an external object. This choice was determined by "the attraction of the opposite sex—the son being drawn towards his mother and the daughter towards her father" (6). The sexual attachment to an incestual object was the core of the psychic constellation later known as the Oedipus complex. The "incest" barrier caused repression of the libido and ushered in the latency period. In the normal course of development the incestual wishes remained repressed and the person detached the libido from the incestual object and subsequently directed it toward a non-incestual object of the opposite sex. Simultaneously, at puberty, the component instincts came under the primacy of the genital zone. Normal behavior was thus ultimately equated by Freud with the successful resolution of the Oedipus complex.

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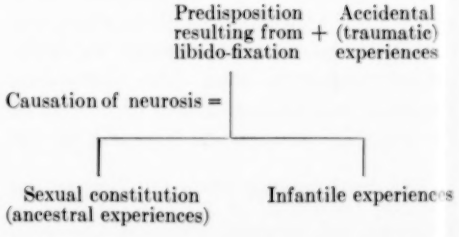
[2] The original term used by Freud to connote sexual drive was Trieb. It has been loosely translated into English as "instinct."

Freud believed that the libido in the neurotic remained fixated to the Oedipal object. This fixation was the result of two factors: accidental, traumatic experiences of childhood and the inherited sexual constitution. In these people the infantile Oedipal conflict, instead of being resolved at puberty was revived with even greater intensity. The repression that had been maintained during the latency period now began to fail, but the incest barrier still barred the forbidden gratification. The person then attempted to reinforce the repression through regression of the libido to pregenital fixation points, but these outlets, too, were blocked by repression. The libido, therefore, sought gratification in neurotic symptom-formation. This theory of object-attachment established the unresolved Oedipus complex as the keystone in the structure of neurosis:

> "One says rightly that the Oedipus complex is the nuclear complex of the neuroses, that it represents the essential part in the content of the neuroses. It is the culminating point of infantile sexuality, which through its after effects decisively influences the sexuality of the adult. The task before each new human being is to master the Oedipus complex; one who cannot do this falls into a neurosis. Progress in psychoanalytic work has resulted in an ever clearer picture of the significance of the Oedipus complex; its recognition has become the shibboleth which distinguishes the followers of psychoanalysis from its opponents" (5).

Freud was struck by the universality of the Oedipus complex in his patients and the prevalence of Oedipal guilt. It was easy for him to account for this guilt where the patient's history clearly showed severe paternal intimidation. However, there were many cases where, as far as Freud could tell, the father's behavior was above reproach. Where, then, did the sense of guilt with its accompanying fears of death and castration come from? Freud decided that the ontogenetic Oedipus complex recapitulated a phylogenetic one, the memory of which was inherited. In the absence of historical evidence for a primal Oedipus complex, Freud invented a self-designated "scientific myth" to account for it. He expounded this thesis in *Totem and Taboo* (7), and postulated a primal horde or family in which the sons killed the father to keep the mother and the daughters for themselves. The sense of guilt which arose from this primal parricide was recapitulated in each succeeding generation as the incest barrier.

The Oedipus complex and its associated guilt were thus permanently lodged in man's genetic constitution. Failure to resolve the conflict could not be explained by a threatening father, but rather reflected the inborn strength of the libidinal drive that was directed toward the mother. Here, again, Freud changed his theoretical emphasis from environment to constitution and reduced neurosis to inherited, instinctual energies struggling for predetermined channels of discharge. Environmental forces in a person's life could designate the point at which libidinal energy might erupt, but the innate course of libidinal development and the objects to whom the libido attached itself were unalterably fixed by heredity. These formulations comprised the classical libido theory of neurosis and were based entirely upon the sexual instinct. The theory was embodied by Freud (3) in his well-known diagram:



The libido theory as first formulated by Freud could not adequately account for all the vicissitudes of behavior because it ex-

cluded the functions of the instinct of self-preservation (ego-functions). The theory was really designed to track down the genesis and integration of the sexual instinct and to supply a schema to identify substitutes for impounded sexual impulses. It became the vehicle for coordinating clinical observations previously considered unrelated. It supplied a workable method for detecting arrests in development and identified maturity with the achievement of the genital level. Thus, the psychoanalyst was enabled to trace the origin of a neurosis and was given a therapeutic goal toward which he could aim. In this sense, for a time, the libido theory was eminently successful and proved a useful adjunct to therapeutic practice.

The criticism that we will make of the libido theory should not blind one to the positive role it has played in the development of psychoanalysis. It is true that it has many extravagances and tautologies, and that it keeps begging the question, but it has in fact been the framework for one of the most important collections of knowledge ever gathered in any psychology. No one who has studied this theory can fail to have taken a vast store of information from it. The contributions of Freud, Abraham, Ferenczi, Jones, and many others are a high testimony to its heuristic value, notwithstanding its faulty theoretical structure. It flourished because it trapped, identified, and correlated a large number of organismic responses more successfully than had any previous frame of reference. On the other hand, this body of knowledge did not, in our opinion, compare in importance with Freud's discoveries in *The Interpretation of Dreams*. In the latter Freud described basic adaptive maneuvers which explained the data contained in the libido theory but without subscribing to its inconsistencies and contradictions. The ego was clearly identified by its activities. It was, therefore, preeminently an "ego agens" or an action ego. It did things. It selected, it coordinated, it organized. It was in constant touch with reality and with its own past. It had a homeostatic function and used a host of coping devices to keep excitations at a minimum level. Of course certain fictions were invented, such as "dream censor," to convey different functions of this action ego. These metaphors did no harm because the emphasis fell on the end product—an alteration in perception accompanied by varying degrees of awareness. The goal of all these means-ends operations was to prevent pain and enhance pleasure. In the libido theory the action ego was robbed of its governing role; its relation to the instinct, which drew its power from phylogeny, was vague; the emotions were buried in energic concepts; "stages of development" were used to identify a regression, and in this way, complex interactions between organism and environment were obscured. For a time the energic concept of the transformation of libido from one form to another even lost for us the dynamics of neurotic anxiety. Freud, himself, gradually became aware that his first formulation of the libido theory undermined the central role assigned to the ego in his earlier works. Subsequently, as we shall see, he attempted to reinstate the ego in the concept of narcissism. This reinstatement took place over many years, and is going on today in the form of ego psychology, which, however, is still burdened with many of the undesirable aspects of the libido theory. Our next task, therefore, is to examine those libidinal assumptions which are of doubtful usefulness in an ego psychology.

The concept "libido" really has two sets of connotations: one of them is appetitive, conative, or hormic (like hunger); the other is energic which means capability of direction, attachment to some object (cathexis), existence in the form of charges of greater or lesser intensity, and capacity for transformation into varying end-forms, like character traits, symptoms, and ultimately even cultural institutions.

The first connotation, the appetitive or hormic, implies that man shares certain attributes of instincts which biologists have identified in lower forms of animal life. The term, instinct, to the biologist implies phylogenetically predetermined and automatic patterns of arousal, motivation, and executive action that are uninfluenced by learning. However this may be with lower forms of life, it is characteristic of man's adaptability that he has very few built-in patterns for executive action. Nevertheless, Freud incorporated this biological concept of instinct into the libido theory and applied it directly to human beings. The result was that the bulk of human behavior was explained as instinctual in its origin.

The theory, however, had inherent weaknesses in many of its underlying assumptions. First of all, the course of instinctual development was supposed to be predetermined by organic evolution. Moreover, this development was recapitulatory in accordance with Haeckel's law of biogenesis, that ontogeny recapitulated phylogeny. When it came to a consideration of *what* was developing, the implication was that the instinct (the *libido*) was developing, and since its course was biologically predetermined, external factors had no significant bearing on this development. In the *Three Contributions to the Theory of Sex*, Freud left room for the modifying effects of accidental events experienced in childhood or later. "It is not easy," he said, "to estimate the relative efficacy of the constitutional and accidental factors" (5, p. 239). No one can say, therefore, that Freud was unaware of the influence of parental character or of cultural demands. Nevertheless, these were not given a decisive role in his theory because "the accidental factor must have a constitutional basis in order to come into operation" (5, p. 239). In consequence, the libido theory was overweighted on the constitutional side, underweighted on the environmental side. It ultimately traced behavior to instinctual forces that were inherent, had a fixed ontogenetic course of development, and recapitulated phylogeny. The role of society, although not neglected, was minimized, and it was quite possible for instincts to find behavioral expression purely on a constitutional basis without any significant interaction with the social environment. It is our position, in contrast to Freud's that the bulk of human behavior is adaptive and learned. The libido theory is a case of the instinctual tail wagging the adaptational dog.

Let us pause here and distinguish more clearly the difference between an adaptational frame of reference and an instinctual one. Adaptation in the biological sense refers to the responses of an organism which enhance its chances for health and survival. Not all activities of living organisms can be considered adaptive. Certain properties such as assimilation, reproduction, and irritability distinguish living from non-living matter. These are not adaptations; they are intrinsic properties of life itself. Adaptation refers only to the means-ends devices for carrying out life processes most efficiently. For example, gastric juices are secreted when nose or eyes are stimulated by the smell or sight of food. This is an adaptation concerned with assimilation. Similarly, reproduction is a property of living protoplasm, but the evolutionary emergence of internal fertilization is an adaptation. The same criteria which are used to differentiate adaptive from nonadaptive processes in biology hold good for psychological phenomena. The biological basis of life cannot be explained by a psychoanalytic theory. This is the ultimate province of biophysics and biochemistry. Psychoanalytic methods of observation can only help us understand the psychological means-ends devices with which the human being adapts to his social environment in order to insure his health and his survival.

Good health in psychological terms is dependent upon the satisfaction of needs. In Freudian theory these needs are the instinc-

tual demands subjectively perceived. Not only are the needs themselves derived from instincts, but the behavior which brings gratification is also held to be instinctual. In our view, psychological needs can be subdivided into two groups according to their origin: physiological and social. The physiological needs are inborn functional expressions of the structural organization of the body. The needs for food, sex, water, oxygen, and warmth fall into this category. The goals of such needs are not learned and one may, if he wishes, call them "instinctual." However, the ways and means by which man pursues these goals are shaped by life experience and are, therefore, adaptations that vary with the physical and social environment. For example, the physiological need for food is biologically predetermined. How to relieve the hunger becomes the focal point of the growing infant's interest. In this way the need for food is transformed into the need for the mother or any substitute source of gratification. The newly felt need for the mother is not inborn, it is not "instinctual," but is a learned association. What the mother signifies and how her care can be controlled and guaranteed are further learned associations. None of them is in itself a derivative of innate protoplasmic requirements, but is the product of the unique interaction of one person with another in a particular social setting.

Unlike the physiological needs, the social needs are not innate. They develop only after the person's exposure to the society into which he has been born, and their nature is determined by the demands of that society. The gratification of such needs as those for status, prestige, or conformity to convention not only relieves anxiety about social exclusion but rewards performance considered socially useful. Here, too, the adaptations required to satisfy these needs will vary with the cultural institutions. Freudian theory, on the other hand, attributes all social behavior of the individual to instinctual forces. Were this true, cultural differences would have little impact on the development of human personality, a conclusion refuted by the cross-cultural studies of Kardiner and others (8, 9).

The second connotation of the libido—its transmutability and subdivision into charges of energy that moved from one zone to another, from one object to another, from one modality to another as symptom, anxiety, character trait, and cultural institution—was a vast elaboration of Freud's earlier concept of psychic energy. The general criticism of this concept that we made in Part I of this paper holds equally good for the libido theory (10). The energic hypothesis is tautological and provides no new knowledge. Just as was true of psychic energy, the concept of libidinal energy remains a metaphorical device for rephrasing clinical phenomena in terms that purport to be quantitative. For example, suppose we observe an infant's relation to its mother. We can say from this clinical observation: The infant is intensely interested in the mother, who is the source of all his gratifications. This is an inference based on observation with which we can all agree, and it tells us something about the mother-child relationship. Suppose now we make use of the energic hypothesis and say: The infant intensely cathects the mother with libidinal energy. This statement does not add anything to our knowledge about the relationship between the mother and the child. We have merely restated the original observation in hypothetical energic terms. Hence, the tautology. Nor can it be argued that the energic hypothesis quantifies the infant's response. It does no such thing, since the degree of quantity is also derived from the original observation and, therefore, is a subjective evaluation made by the observer. Thus, if the observer infers that the infant's interest in the mother is "intense," he will say the cathexis is "intense;" if he infers the interest is "weak," he will say the cathexis is

"weak." Here, again, the notion of any "quantity" of energy is purely tautological.

Freud's emphasis on constitution, instinct, and energy soon led to serious operational difficulties. The concept of character traits is a good example of the limitations of the libido theory when applied to clinical data. Freud had noted a relationship between the "anal character traits" (orderliness, parsimony and obstinacy) in the adult and severe toilet training in childhood. Although fully aware that the child responded to anal training with obstinacy and defiance, Freud did not account for these traits as adaptive responses to discipline, but derived them from transformations of the libido. He attributed the difficulty the child had in accepting toilet training to an anal fixation. In other words, the child had a vested interest in anal erotism which he protected by resisting toilet training. He eventually gave in, but at the cost of repression of the anal libido, which subsequently was transformed into anal character traits by means of reaction-formation, desexualization, and sublimation. We would like here to quote Freud's own description of this process:

> "I know that no one feels inclined to accept a proposition which appears unintelligible, and for which no explanation can be offered, but we can find the basis of such an explanation in the postulates I have formulated in my *Drei Abhandlungen zur Sexualtheorie*. I there attempt to show that the sexual instinct of man is very complex and is made up of contributions from numerous components and partial impulses. The peripheral stimulation of certain specialized parts (genital, mouth, anus, urethra), which may be called erotogenic zones, furnishes important contributions to the production of sexual excitation, but the fate of the stimuli arising in these areas varies according to their source and according to the age of the person concerned. Generally speaking, only a part of them finds a place in the sexual life; another part is deflected from a sexual aim and is directed to other purposes, a process which may be called sublimation. During the period of life which may be distinguished as the 'sexual latency period,' *i.e.* from the end of the fourth year to the first manifestations of puberty at about eleven, reaction-formations, such as shame, disgust, and morality, are formed in the mental economy at the expense of the excitations proceeding from the erotogenic zones, and these reaction-formations erect themselves as barriers against the later activity of the sexual instinct. Now anal erotism is one of those components of the instinct which in the course of evolution and in accordance with our present civilizing education has become useless for sexual aims: it would therefore be no very surprising result if these traits of orderliness, parsimony, and obstinancy, which are so prominent in persons who were formerly anal erotics, turned out to be the first and most constant results of the sublimation of anal erotism" (2)

Thus, Freud discarded the empirical evidence of his own clinical observations in favor of the constitutional bias of the libido theory. He believed that the course of development of anal character traits was organically determined and fixed by heredity. He did not ignore the significance of education in children, but denied that its role was primary. In other words, the etiological emphasis Freud placed upon consitutional and instinctual processes devalued the cultural factor (toilet training) and made a mystery of the interaction between the child and his social environment.

What is wrong with such explanations? They have one great fault. They are based entirely on unprovable assumptions. Thus, it is assumed that there is a sexual instinct that has a constiutionally-fixed course of

development; it is assumed that anal character traits are derived from impounded sexual impulses; it is assumed that there is a constitutional fixation of an anal erotism; it is assumed that there is a sexual energy called the libido; it is assumed that this energy is capable of transformation through assumed processes into habitual patterns of response called character traits. All of these assumptions derive from fictitious concepts that are unrelated to clinical data and hence can be neither validated nor refuted. In this sense, they fail to satisfy the criteria we have set down for scientifically useful assumptions.

This new theoretical position removed the repression of pregenitality and the formation of character traits from the influence of those central discriminating and coordinating functions attributed to the ego in the earlier papers on defense and in *The Interpretation of Dreams*. These important functions were no longer exercised by an integrating psychic agency, but became the inherent expressions of instinct operating on phylogenetic momentum. The theory, therefore, ignored the central integrative role of the ego as the instrument of adaptation. It became extremely difficult to describe adaptive processes within this framework because the mediator between the organism and its environment had been removed. It thus became impossible to define the interaction between a person and his culture.

How would we explain the so-called "anal character traits" adaptationally? We would introduce a cultural directive, cleanliness, mediated by the parents in the form of toilet training. This cultural demand comes in conflict with the child's desire to defecate without restriction whenever and wherever he pleases. The child's responses to this demand are nothing more than reactions to discipline. The ultimate nature of these responses is determined by the degree of intimidation imposed by the parents. In the course of the power struggle that ensues, the child shifts his attention from the simple pursuit of unrestricted anal function to the demand of the parents that he limit his freedom of action. As a result of this shift, anal function, per se, assumes secondary importance and the struggle with the parents becomes the primary concern of the child. He can respond predominantly with fear, in which case he will gradually integrate patterns of cleanliness, orderliness, submissiveness, reliability, and punctuality; or, he can respond predominantly with rage, in which case he will gradually integrate patterns of disorderliness, obstinacy, defiance, parsimony, unreliability, and unpunctuality. Usually, he responds with both emotions, but vacillates between the two. The emotion which gains ascendency, and most often it is fear, determines which group of "character traits" will eventually predominate. Once these techniques of coping with authority are laid down, they are no longer limited to anal function, but are automatically extended to other areas of behavior. In this way, all relations with people are patterned after the original infantile model and are perceived in terms of defiance or compliance, dominance or submission. The "anal character traits" described by Freud are merely adaptive techniques for controlling the actions of parents or parental surrogates in accordance with the underlying emotions of fear and rage. They are, therefore, security devices, and not hypothetical transformations of an undemonstrable sexual energy by unknown mechanisms.

Let us turn next to the Oedipus complex. This family constellation, named after the Greek version, has become a central reference point in psychoanalytic literature. It is used both as the "cause" of a neurosis and as the manifestation of a neurosis. All neurotic configurations are described in terms of the Oedipus complex. The fact is, however, that the Oedipus complex as used by Freud is not universal in the form of the Greek myth where the family conflict was between son and father for the love of the mother. The Egyptian myth, for example,

emphasized sibling rivalry, because the family constellation was dominated by brother-sister marriage; the Hebrew myth, on the other hand, was dominated by the absence of a maternal figure and emphasized strict and total obedience to the will of the all-powerful father.

In *Totem and Taboo* (7) Freud accounted for the existence of the Oedipus complex as the unconscious memory of an ancient crime —the primal parricide. Since then man has been overtaken from time to time with waves of guilt. That is why he had to invent the concept of original sin and why the Eucharist contains the memento of the primordial cannibalistic act. Though no one contests the existence of the Oedipus complex we believe it can be accounted for on grounds other than the scientifically unprovable hypothesis of inherited memories. We can account for it, rather, on the basis of its ontogenesis in a particular environmental setting called the family.

The anthropologists have taught us that there are many types of family: monogamous, polygamous, polyandrous, etc. They are all descendants of specific forms of social evolution. Their persistence is an indication of expediency or necessity. There is no definite information at hand concerning the relative merits of each type of family organization. What evidence we do have is largely indirect. Thus, we do not know of any great society that has survived as polyandrous. Polygamy is apparently a perversion of the monogamous pattern caused by unequal distribution of wealth. We do know that the great stable societies have been monogamous and that recorded history begins with patriarchal dominance. We do not thereby say that Western societies, such as the Greek and Roman, grew great because of their monogamous pattern, but rather that this pattern survived because it furnished very favorable conditions for the growth of the young. It provided a protective environment which fostered the development of the capacity to love and of conscience—the implements of social cohesion.

What Freud called the Oedipus complex was a particular kind of interaction between the child and his parents within this particular familial setting. His insistence on a constitutional explanation, however, resulted in an over-simplified picture of automatic and inherent sexual conflict in the life of every child. Some were fated to remain at the Oedipal level of development, others managed in a mysterious way to resolve the conflict by repression and sublimation. The love of the child for the parent of the opposite sex, therefore, was but another manifestation of the sexual instinct. Freud made no clear distinction between the non-erotic and erotic aspects of this attachment to the parents. The fact is, however, that clinically the child has both, and each has a distinctive developmental history of its own. Let us consider the non-erotic component first.

Freud's theory ignored the influence of the protective environment on the induction of tender feelings toward those objects who provided the protection. The parent first furnishes the child with the conditions that permit him to develop a feeling of omnipotence because all of his needs are satisfied on demand, as if by magic. Later, the child delegates this power to the parent. It it this rewarding relationship which both generates tender affectivity in the child and permits idealization of the parent. Freud assumed, however, that the development of affectivity was an automatic expression of instinctual processes, but in recent years it has been experimentally established that affectivity and idealization will develop favorably under some environmental conditions and not under others (1). The ability to express love is inducted by the object, not by an inborn instinctual drive.

How shall the recognizable sexual interest of the child in the parent be explained? Must we rely on sexual constitution, as did

Freud, or is there an adaptational explanation that does not depend upon unprovable assumptions? We believe there is. Here we must distinguish between sexual drive and sexual object. Every human being is equipped with an inherent genital apparatus for sexual arousal and discharge, and from this standpoint the sexual drive may be considered inborn. On the other hand, we cannot say, because we do not know, to what extent there is in man an inborn need either for a sexual object in general or for a sexual object of a particular gender. We do know, however, that the particular choice of object that is made is markedly influenced by the growing child's dependent relationship with his parents. In this sense, the ultimate choice of object is a learned pattern of behavior.

The child first experiences sexual pleasure through the manipulation of his own genital. This early genital activity requires no object other than the child himself. The shift in sexual interest to an external object comes about only after he has established a close affectional tie to his mother. Her love, so necessary for the child's security, is always measured by her readiness to gratify any of his needs, either for pleasure or for protection. Once his attention has been drawn to his own genital as a pleasure-source, the child expects his mother to become the vehicle for genital pleasure, too, as well as for all other pleasures. The urge for the mother to participate in his genital activity, to stimulate and to caress him, is based not on an innate attraction to the opposite sex, but is a special way of reassuring himself that her love remains at his disposal. The issue gains added significance for him as he becomes aware that he does not fully possess his mother, but must share her with his father and siblings. This awareness intensifies his need for the exclusive possession of the mother as the dependency object. To this point both male and female children are interested primarily in the mother and there is no essential difference in their sexual development as far as the first choice of object is concerned. There is a difference, however, in the attitude of the little girl toward her genital equipment. She attributes the privileges of greater freedom in play and assertion given the boy in our society to his possession of the prized organ, the penis. This is the infantile origin of so-called "penis-envy" and it may generate the hostile wish to castrate the boy, an impulse which must be repressed because of the fear of retaliation. As will be seen, this "penis-envy" plays an important part in the later appearance of sexual fears in women.

The little boy's attempts to cling to his mother sooner or later meet with the overt disapproval of his parents, who unconsciously transmit the incest taboo of the culture. This is the origin of the sexual component of the Oedipus complex. The boy's response to intimidation is two-fold: the hostility toward the father, who stands in his way, must be repressed because of fear of castration, and he must further protect himself by repressing the forbidden desire for the mother. As the mother becomes inaccessible, he retreats for sexual pleasure to his own genital and to sex play with other children. If this compromise is not interfered with, his Oedipal conflict is resolved by the substitution of himself and non-incestual objects for his mother. In such circumstances the possibility of sexual inhibition is reduced to a minimum and the development of healthy sexual patterns in the adult is fostered. This appears to be the case in those societies that freely permit masturbation and sexual experimentation with non-incestual objects in childhood (8, 9). The trouble starts, however, when the culture also interdicts the substitute choices of self-stimulation and sexual games with playmates. This is what happens in our culture. Then the circle is closed. The boy must conclude that not only his desire for his

mother is bad, but, since all other objects are also forbidden, it is sexual gratification as such that must be given up. This is easier said than done. He may succeed in repressing his sexual need, but only by relegating its satisfaction to unconscious fantasy. He chooses the mother, once again, as his object, since the inhibition of independent executive action forces him to fall back upon the earlier dependent attachment to her. The Oedipus complex is thus perpetuated. All subsequent heterosexual objects are identified with the forbidden mother and evoke castration anxiety, which is the starting point for future disorders of sexual function.

The sexual development of the girl is somewhat more complicated. As we have already stated, the first sexual object for the girl is also the mother. Why does the little girl turn to the father? In our culture it is not so much a question of intimidation, as in the case of the boy, but a consequence of subtle persuasion by both the mother and the father. The mother discourages any sexual interest in herself and shifts the little girl's attention to the father by the example of her own behavior. In this way, she helps the child, first, to emulate her, and then, later, to identify with her in the sexual role of a woman. The father not only offers no objection, but facilitates the process by playful seduction. The behavior of the parents is reinforced by the weight of the social institutions which constantly emphasize that the highest goal for the girl is an attachment to the male. A contradiction develops when the parents, who initiated the shift in the first place, become alarmed at its sexual significance to the little girl and hence institute sexual intimidation in exactly the same manner that they did with the little boy. The little girl has by this time become aware of the genital differences between the sexes and unconsciously attributes the absence of a penis to a punitive castration by the mother for her Oedipal strivings. From here on the sexual development of the girl proceeds in the same manner as that of the boy. The Oedipal strivings are perpetuated as unconscious fantasies, since sexual gratification through masturbation and sex play with other children is prohibited. We must take issue with Freud's contention that castration anxiety terminates the Oedipus complex in boys, but initiates it in girls (4). As far as we can make out the relationship of castration anxiety to the Oedipus complex is the same in both sexes. It is always the castration anxiety which sets in motion the repression of Oedipal strivings.

The sexual inhibition in women which results from this early development is abetted by two social institutions that define the feminine role. One of these requires the woman to present herself as chaste, virtuous, and disinterested in sex. This standard facilitates the repression of sexuality and rewards frustration with enhanced moral stature. The other institution has to do with the relative status of men and women in our culture. Men are considered strong, superior, and dominant; women are considered weak, inferior, and submissive. The penis becomes the unconscious symbol of masculine strength and the man's preferred position. This re-enforces the earlier "penis-envy" from childhood and further inhibits the woman sexually. She places intercourse in a dominance-submission context, in which the woman is not only subjugated by the male, but is exposed to injury by his symbolic weapon of power, the penis. This encourages the reparative fantasy of taking away the man's penis, not merely to deprive him of its use, but to gain its power for herself. Such a view of intercourse inevitably intensifies her fear of retaliation. Furthermore, penetration by the penis also arouses the repressed Oedipal strivings and the associated guilty fear of punishment by the mother, thus adding another increment of retaliatory fear. The net result in women

with such unresolved conflicts is withdrawal and flight from the sexual act and sexual pleasure.

In this part of the paper we have traced the historical development of the libido theory from its inception to the concept of narcissism. We have tried to separate the scientifically useful assumptions from those of constitutional predisposition, instinct, and energy, which, in our opinion, give us no new knowledge. Those aspects of the theory that we feel are useful are the clinical applications of the earlier discoveries made by Freud in *Studies in Hysteria* and in *The Interpretation of Dreams*. We have tried to show how the libidinal concepts of phylogenetic inheritance and instinctual energies hinder rather than help our understanding of the psychic mechanisms by which different forms of behavior are integrated. They interfere with conceptualization of adaptive processes and take attention away from the problems of human adaptation, which should be the major concern of psychoanalysis. Finally, the libido theory, to us, is a closed system of explanation that compresses all observations of behavior into a rigid schema and thus hampers research and the accumulation of new knowledge. In the third section of this paper we shall examine Freud's first effort to create an ego psychology within the framework of the libido theory by means of the concept of narcissism and the dual instinct theory.

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THE ADAPTIVE SIGNIFICANCE OF THE DREAM

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Whatever the biological function of dreams may be for the human organism, their usefulness to the psychotherapist rests upon one intrinsic quality, namely, their remarkable capacity to integrate past experiential data with current life situations in a manner that discloses more significant information pertaining to current conflicts than is available to the individual at any given moment in the waking state. The question may be formulated in another way: Why is it possible for an individual, while asleep, to experience in the form of dream consciousness all of the forces at work in a current life situation, and to present them with due regard to their relative importance and manner of relatedness, whereas, by contrast, they are experienced in the waking state in a fragmented, partial, or expedient manner?

Three sets of conditions all uniquely pertaining to the sleep state have a bearing on this question. Sleep is characterized by alterations in the physiology of the cortex; the occurrence at times of partial cortical arousal experienced as the dream state; and the absence of communication needs during the sleeping phase of the sleep-waking cycle.

PHYSIOLOGICAL FACTORS

In previous communications (1–4) attention was called to certain physiological considerations and their possible bearing upon our understanding of the formal aspects of dream consciousness. These formal aspects include the employment of concrete means of presentation (predominantly in the form of visual imagery), the sense of immediacy (the dream as an experience in the present), the involuntary quality (the enforced nature of the dream experience), the spatial and temporal distortions, and the transgression of the laws of logic. It was suggested that in the absence of the continuous afferent stimulation characteristic of the waking state, the integrating activity of the central nervous system is qualitatively altered. Stimuli arising during sleep, whether of a somatic or psychological nature, are not identified in their spatial and temporal context. They are not accurately conceptualized. Their manner of integration remains (in the case of physical stimuli) or is reduced to (in the case of psychological stimuli) a sensational level. Two illustrations may clarify this statement. When a physical stimulus is experienced during sleep, it is not experienced accurately for what it is, but the sensory quality does register. A sudden cool breeze, for example, may give rise to images of a violent hurricane or snowstorm. What appears as the exaggerated quality may also be appropriate as an indicator of the relative sleep-disturbing potential of a stimulus suddenly appearing in an otherwise quiescent sensory field. The outside stimulus has now been transformed into a dream image *replacing* the outside stimulus. As an image, it is in turn experienced *sensationally*, *e.g.* as if it were being perceived. By virtue of the existence of reverberating circuits between the cortex and the subcortex, the dream itself is a source of stimuli impinging upon the ascending reticular system in the brain stem raising or lowering its arousal potential.

An analogous situation obtains in the case of psychological stimuli arising during sleep, presumably around memory traces of a recent event. In this case, however, a *reduction* process occurs. The abstract conceptual elements denoting the experience are reduced to a sensory form. In the case to be presented, the probing activity occurring during the analytic hour was depicted in a

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dream in imagery involving a peeping Tom peering through a window into the patient's room. The subsequent course of events in relation to the activating system is as outlined. Thus, despite the source of the stimulus (exteroceptive, enteroceptive, or psychological) or the nature of the imagery (simple or complex), the dream functions as a sensory stimulus and as such plays a role through its effect on the arousal center in bringing about either full awakening or the return to a deeper and dreamless sleep.

In two of the papers cited above (1, 2), the theory offered to explain these features of dream consciousness was based on the Pavlovian concept of the altered relations between the primary and secondary signalling systems during the transitional stages between deep sleep and waking. Pavlov conceived of the primary system as concerned with direct signals of reality whereas the secondary system, built up on the basis of language, enabled the human organism to guide its activity through signals of signals in the form of verbal abstractions. In the transitional state, the primary signalling system assumes dominance over the secondary. Under these circumstances all stimuli, including the conceptualizations associated with past experiences, are integrated at a sensory level and appear to the sleeping individual as direct signals of reality.

TRANSITIONAL CONSCIOUSNESS

The second set of conditions has reference to the temporary quality of dream consciousness. The dream occurs at a time when the cortex is in a state of partial arousal. The consciousness at this time is a transitional one and is unstable in the sense that its resolution has to occur either in the direction of awakening or of returning to sleep. It is the individual's biological environment which controls this state of affairs. Consciousness participates by influencing this environment in a certain way. By a sequential series of images, the individual forms a statement that represents a total assessment of the currently disturbing life situation as well as the defensive mechanisms whereby it can be handled. In so doing he transforms the psychologically disturbing event into an evaluative stimulus which in turn determines whether full arousal has to occur or not. Thus in sleep he is confronted by the biological necessity to depict the experience in a way that enables it to play a role in arriving at one of two entirely different states of being—sleeping or waking. While awake, the individual is not forced to make a decision to alter his state of being in any such total sense.

This formulation suggests the connection between transitional or dream consciousness and the vigilance needs of the organism. With the dissolution of waking consciousness, the individual temporarily suspends his ties to the outer world. Transitional consciousness, linking past data to currently acting stimuli, provides a means of assaying disturbing events in regard to the relative safety or danger associated with continuing sleep. To be effective as a vigilance operation, the dream has to say as much as possible about the disturbing event. Conceptions incorporated into the concrete imagery of the dream integrate many experiential fragments from the life history of the individual, unconnected in time but connected in their relevance to the current problem.

COMMUNICATION

One further condition makes the sweeping interpretive power of the dream possible. This has to do with the absence during sleep of the need to communicate the implications of the threatening event. This makes it relatively safe to experience them. It is only in the waking state that communication through language is possible. Language may appear in the dream, but it does so within the setting of concrete imagery and for the purpose of developing the sensational impact of the imagery. When the dream is recaptured in the waking state, it is as an

anomalous fugitive from the sleeping state. To transform it into an instrument for use in the waking state now involves an uphill struggle. Language, in the form of relevant associations, enables the element of communication to come into the picture. What occurs beyond this point in terms of the contribution the dream can make to a deeper level of understanding in waking life is then a function of the nature of the therapist's efforts and the patient's neurosis.

DREAM INTERPRETATION

Some of the theoretical points outlined will be considered in relation to the following clinical material.

The patient is a 30 year old woman, married for ten years, with one child of five. She has been in psychoanalytic treatment for three months. Difficulties in many areas of living finally culminated in her decision to seek help. Her complaints were:

1) General feelings of inadequacy and dependency in her marriage. She wants to, but cannot reciprocate the love and support her husband extends to her.

2) Specific sexual difficulties. She has never experienced orgasm and engages in the sexual act in an inert fashion to satisfy her husband.

3) A sense of inadequacy and lack of self-confidence in her work as an interior decorator.

A specific situation actually precipitated her into treatment. A close and enduring friendship with another married woman terminated in a violent and recriminatory manner. The two couples had been intimate friends over a period of many years. The patient had a dependent, anaclitic relationship with this woman and the break was followed by a profound sense of loss, depression, and continual preoccupation with the affair.

Briefly, although she appears to be an individual with many assets, including a generally attractive personality and a lively intelligence, she has, despite good intentions, shown a penchant for getting into difficult personal situations and always needing a stronger figure to rescue her.

Her initial reactions in treatment might best be described as "protective inadequacy." Her feelings of inadequacy were so expressed as to always contain an apparently logical and therefore compelling invitation to the therapist to step in, give advice, and assume the role of being the sole active agent. To the newness of the treatment situation she added a gratuitous aura of mystery; to the problem of being a novice at dream interpretation she added the further problem of feeling a deep estrangement from her own dreams. One encounters a variety of reactions by patients to the challenge of working on dreams. At one extreme is the "I can do it myself" group. At the other, which includes this patient, we have the "I know it's my dream, but I can't do a thing with it" category.

Two sessions before the hour to be discussed, she presented the following dream.

"Milt [husband] and I and two others were in the dream. He and I were watching someone shinny up a tall pole, a flag pole. When he got to the top, he lay down and relaxed. Milt asked, 'Do you think we ought to try?' I said, 'You go first.' He did. Then I did. We were both relaxing on top and watching the others go down. One got down by jumping. I started to feel very uneasy. I said to Milt, 'You'd better go first.' He slid down halfway and jumped the rest of the way. He said, 'Okay, you choose your way.' I was frightened but found that I made my way down easier than the others by grabbing the circumference of the pole and sliding all the way down."

Her initial response was, "This makes absolutely no sense to me." When efforts to pursue the dream directly failed, the therapist raised the tentative speculation that perhaps some of the symbols expressed in the dream might be related to matters of a sexual nature.

A grudging admission brought up the next

impasse, verbalized along the familiar lines, "So where does that get us?" Still in the dark as to why she had the dream at this particular time, and what it meant, the therapist continued his questioning. The next one apparently reached its mark. I asked her what she had been doing and thinking just before she had fallen asleep. She suddenly remembered that she reluctantly had had intercourse with her husband. The feelings of distress in connection with this, which she had formerly dealt with in a general way, now had to be spelled out in relation to a specific recent experience. These included all of the feelings associated with her contradictory state of inner resistiveness and outer compliance. She felt hypocritical, guilty, inadequate, and annoyed. The important point, however, was that this particular question punctured the amnestic facade that enabled her to look *only* in the therapist's direction for help with the dream. Behind the conscious and, as far as it went, honest conviction that she was cooperative in working on the dream, she was at the same time engaged in a series of fencing, hiding, shielding, and withholding operations. To have continued in these neurotic defensive maneuvers in the face of this direct question would have involved her in the act of consciously lying. This she was not prepared to do. We are not concerned here with the meaning of the dream, but rather with the following sequence of events.

First, the patient's efforts to cope with the problem of dream interpretation followed a path that was consistent with her life-long anaclitic pattern of relatedness. She was structuring the therapist as the Delphic Oracle, to whom she could come for the interpretation.

Second, therapeutic intervention disclosed both the source and manner of her own participation in the joint task of dream interpretation.

By error, the patient came exactly one hour too late for her next appointment and could not be seen. The hour she did come was one which she had had up to two weeks before, when it had been changed to the preceding hour. She had forgotten about the change, despite the fact that the week before she had come at the new time. She was very chagrined and troubled by her mistake.

In the next hour, she presented the following dream and up to a point seemed to interpret it correctly. She had had this dream on the night following her last therapeutic session.

"The setting is a school or college, with tall buildings around a campus. The atmosphere is rural or suburban. There is a young man trying to see into a window. He is a peeping Tom, but not exactly. There is a man and a woman there. I'm not sure, but they may have been making love. The man was going through a very precarious situation. He was walking on a ledge as he was trying to look in. The woman came to the window and was very indignant. The man came close to falling off the building and breaking his neck. Then the scene changed. I was in a locker room. I had gone swimming. It was a very involved, complicated place. I was looking for my locker and a dressing room. I had the feeling I was going to find it."

Her own interpretation established the following connections.

1) She felt that the dream referred to the probing activity of the previous hour.

2) She felt it had to do specifically with the sexual material.

3) She recognized the element of danger. She could not relate it to the therapist, but only to the sense of danger she felt at those critical moments when she feared a catastrophic break-up of her marriage.

Beyond this, any further direct interpretative work on the dream was impossible for her. However, other associations occurred during the hour which she didn't fully understand. Their occurrence revealed a partial, fragmentary grasp of their relationship to the dream.

1) She recalled an earlier dream at the time of her pregnancy—one which had as its theme being incarcerated in a place where she was being taught how to be a doormat and was finally rescued by her husband.

2) She recalled this as the only dream prior to the present one which she felt she had interpreted. She herself at the time thought it had to do with her pregnancy and that having a child would make a doormat out of her.

3) For the past few months the patient has again been trying to become pregnant. She is still ambivalent about it, but less so.

4) She spoke about her great dependency on her husband and his role as rescuer in her life. He had initially opposed her coming to treatment and had attempted to act the role of psychiatrist to her.

Based on the associative data as well as my knowledge of the patient, I felt that the dream dealt with a whole array of material, not clearly perceived consciously, but all related to and following upon the first effective tampering with her dependent structure.

Fundamentally, the dream revealed a wealth of information concerning the situation between the patient and the therapist. The patient believed herself to be in a state of frank, open, and direct communication with the therapist. The real situation was otherwise. The therapist was on the outside and desperately trying to get a look in, an action which was resisted and warded off. The man with her in the room was also the therapist on the basis of previous hints of erotic transference and the absence of any expression of erotic feeling toward her husband. It was as if the therapist, having succeeded in exposing her negative feelings toward her husband, might now discover her positive feelings in fantasy form toward the therapist. This constituted a source of danger to her because it would leave her without that inner sense of independence and aloofness which existed as her only compensation for the self-enslavement she structured for herself. In view of her remarkable dissociative abilities, however, the danger was not yet directed at herself, but toward the therapist. This was so because, as symbolized by her not coming to the preceding hour, she was still capable of warding him off, and—in effect—throwing him off the ledge. Her faith in her neurotic solutions emerged in the ending of the dream in which she is seeking a locker and had the inner certainty that she will find it, even though it was a bit more complicated than she had expected. The women's locker room was a way of flaunting her feelings of safety from men. Here she could dress with no peeping Tom to look in on her.

The situation was somewhat analogous to the state of affairs existing at the time of her pregnancy. Here again, an outside agency, this time in the form of a child, threatened her dependency pattern and necessitated a rescue in the form of shifting the new responsibilities over to her husband. She had some identity in her relationship with her husband whereas, without him, she would be an anonymous doormat. At the point where the treatment, by virtue of her erotic fantasies toward the therapist, threatened this relationship, she symbolically sacrificed the therapist.

This dream has been presented in order to illustrate more clearly the following theoretical points.

1) The dream, in its connection with its vigilance function, is concerned with reality events that upset the equilibrium of the individual. In this instance, the vigilance needs are aroused by a threat to the psychological structure following upon the interchange during the first hour.

2) The recency of this experience as well as its disturbing quality accounts for its reappearance during sleep.

3) The experience gains expression in the dream in the form of concrete imagery.

4) The developing imagery expresses relevant historical connections to the current

threat as well as the upsetting impact of the threat.

5) The imagery further depicts the strength of the neurotic defensive countermeasures summoned into action by the therapeutic inroad. This has reference to the ending of the dream where the patient is devising a situation of safety for herself.

6) In this instance, the total sequence of events did not form a sufficient stimulus to result in arousal. Deeper sleep was resumed, accompanied by a dissolution of the dream.

SUMMARY

Some of the characteristics of the dream have been explored in relation to the conditions prevailing during sleep.

Attention was drawn to the possible role of neurophysiological changes during sleep in accounting for the concrete level of dream presentations, the role of the reticular activating system in determining the direction and resolution of the transitional dream consciousness, and the relation of the dream to the problems of psychological vigilance during sleep.

Clinical material was presented to illustrate the theoretical points under discussion.

The dream appears to be man's unique means of coping with his biological environment when, as in sleep, that is all that exists for him, just as waking consciousness is the unique instrument for achieving mastery over man's social environment when that dominates the scene.

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PERSONALITY DYNAMICS IN TORTICOLLIS

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Torticollis or wry neck is an unusual and relatively rare symptom. Paterson (22) reports that only 21 cases of torticollis were observed over a ten year period in a total admission population of 2500 patients. Although an extensive literature exists concerning torticollis, for the most part this consists of anecdotal reports or analysis of a few selected case histories. One notable exception is the series of studies by Herz *et al.* (13, 14) covering in a systematic manner the physiological, clinical and treatment aspects of the disorder. Herz (14, p. 129) gives a formal definition of torticollis " . . . as abnormal involuntary innervation of muscles of the neck resulting in more or less sustained movements or in deviation from the normal of the posture of the head." Herz and Hoefer also make the important point that torticollis is not identical with a simple voluntary turning of the head. Analyzing motion pictures and recordings of muscle action potentials of torticollis patients, they observe the physiological pattern to be far more complicated than the clinical appearance. A conflicting movement, an antagonistic turning simultaneously toward and away, is suggested.

Patterson and Little (23) as well as Herz and others are in agreement that the clinical picture of torticollis is that of a person with a twisted neck, usually with the head turned in a more or less fixed lateral position. Pain, muscular spasms and muscular rigidity characterize the disorder. Because of the intermittent nature of the muscle activity, the syndrome is frequently referred to as spasmodic torticollis. In some cases, so severe is the turning of the head as to cause the person to spin about in a complete circle. Ordinarily the twisting disappears during sleep and for a brief period on awakening. Patients frequently develop repetitive gestures to control the twisting, such as placing a finger against the chin or face. The disorder may persist for months or years and usually appears rather suddenly. It may disappear as suddenly and spontaneously. Emotional stress usually results in severe exacerbation of the symptom.

Beyond this descriptive summary there is little agreement concerning the etiology and treatment of torticollis. One group of investigators (23) maintains that the disorder is primarily organic in origin. A lesion in the extrapyramidal area or corpus striatum is often hypothesized as the primary etiological factor. However, no systematic study reporting such positive findings at autopsy is available.

Another large group of authors (1, 13, 28) contends that in younger patients, mainly those under 40 years, with no demonstrable neurological or infectious disease or congenital abnormality, the disorder represents a conversion symptom. This school of thought maintains that as a type of conversion hysteria phenomenon, the symptom is to be regarded as a purposive act which carries for the patient a variety of psychological meanings. Indeed, most authors make it amply clear that the torticollis symptom is vastly overdetermined and the twisted neck may hold for the patient a wide array of symbolic meaning. For example, the following are some hypotheses about the dynamics of torticollis drawn from the psychiatric literature: 1) Libidinization of the neck occurs so the neck assumes unusual symbolic significance of a phallic nature (21, 26); 2) Twisting of the neck and head depicts a turning and looking away from adult responsibilities (3, 27);

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3) The turned head represents guilt and shame over past transgressions (hanging one's head in shame) (3, 18); 4) The wry neck is punishment for repressed hostile wishes toward parental figures (3, 18, 27); 5) The turned head is a regressive phenomenon representing the infant's seeking of the breast (1); 6) In a general way torticollis is a turning away and a looking away from something painful or intolerable in the environment (15, 18).

The present study is concerned with the examination by means of psychological tests of these and other personality dynamics in a sample of torticollis patients. There are in the literature two studies (9, 13) reporting the application of psychological testing to a torticollis population. Unfortunately in neither investigation are any of the test findings listed. An interesting footnote to the present study is the fact that it did not begin with a carefully planned research design. Because of the infrequent incidence of torticollis, the project had its origin in the clinical investigation of the occasional patient referred for psychological examination. Only after a number of these interesting people had been seen, was an effort made to examine the sample systematically. It should be mentioned that this manner of conducting research contains certain advantages and disadvantages. Although such a study inevitably lacks some of the scientific rigor desirable in research, one is at least not biased during the data collecting phase by any preconceived hypothesis or theoretical position.

SUBJECTS

Seventeen patients diagnosed as torticollis, conversion reaction, were administered the Rorschach, Draw-a-Person, and in most cases, the Thematic Apperception Test (TAT). Twelve of the patients were examined by the writer over an eight year period, at the Veterans Administration Hospital, Houston, Texas. Data on the remaining five cases were obtained from professional colleagues in various parts of the country.[2] These patients were all white male veterans ranging in age from 28 to 45 years, with a mean age of 36 years. Educational achievement ranged from 8th grade to college training, with a mean grade level of ten years. Four of the patients had experienced torticollis symptoms intermittently for as long as twelve years. With the majority, however, torticollis was a relatively recent symptom, having its onset a few weeks to three or four months prior to hospitalization and psychological testing. As a group the torticollis sample had been cleared of neurological or infectious disease or congenital abnormality. Since the data collection did not originate as a clearly defined research study, identical tests were not available on all subjects. Rorschach records were available on all 17 patients, figure drawings on 14 and TAT's on 15 of the torticollis group.

A control group of 20 patients was also examined by the author; Rorschach, TAT and Draw-a-Person tests being obtained in every case. Members of both subject groups on whom TAT records were available had given stories to at least Cards 1, 2, 6BM, 7BM, and 17BM. In both groups the mean number of TAT stories available was eight with a range of 5–10. The groups did not differ in respect to length of story. Neither group differed significantly in terms of Rorschach productivity. Median number of Rorschach responses given by the torticollis group was 22, with the control median being 20. This difference does not approach statistical significance.

Eleven of the 20 control subjects were drawn from a conversion hysteria sample reported in previous research (8). These patients comprise a group diagnosed as conversion hysteria, with the symptom involving an organ of the body other than the head

[2] I wish to express my appreciation for loan of the psychological test data to the following VA psychologists: Drs. J. J. Brownfain, Dearborn, Mich.; R. W. Fingar, Boston, Mass.; S. B. Kutash, East Orange, New Jersey.

or neck, such as a paralyzed arm or muscular stiffness of a leg. As a group these patients were comparable to the torticollis sample in respect to age, education, race and veteran status. Chronological age varied from 24 to 44 years with a mean age of 34 years. Educational achievement ran from 7th grade to college graduate with a mean level of 11th grade. Duration of symptom varied from a few weeks to eight years, with a mean duration of illness of three months.

In referring to these conversion hysterics as a "control group" an assumption is made that the principal differentiation between this group and the torticollis cases is in symptom choice. Both populations had been diagnosed as conversion hysteria by the examining psychiatrists. The torticollis patients constitute a homogenous group as to symptomatology, while the control hysterics present a variety of involved body organs. One can argue that selection of a conversion group as a control sample represents a conservative choice for comparison since presumably both groups share certain personality traits common to conversion hysteria.

PROCEDURE FOR DATA ANALYSIS

Analysis of the test material proceeded along the following lines. A clinical appraisal of each test battery was made in order to determine themes, symbols and personality conflicts revealed in the material, unique to one or the other of the subject groups. Wherever possible, the test records were examined to ascertain whether hypotheses concerning dynamics of torticollis found in the psychiatric literature gained support. Differences between the groups for all the scored items were tested for statistical significance, using the chi-square technique. Cutting scores were established in each case by using the median score for the combined groups.

As a final check on the objectivity of the themes in the test protocols felt to be characteristic of the torticollis group, five randomly selected test records were given to each of three experienced clinical psychologists.[3] These judges were asked on a blind basis to record the major personality themes or dynamics suggested in each subject's test material. These judgments were then compared, together with those of the author, for degree of agreement.

HYPOTHESES AND RESULTS

Examination of previous research and anecdotal reports of torticollis patients resulted in the identification of a number of dynamic formulations to be studied using the projective test material. Many hypotheses posited had to be rejected for examination as either being entirely too general ("torticollis is an obsessive compulsive condition" [24]) or too highly restricted ("torticollis is a masturbatory equivalent" [1]). The following dynamic trends were selected for exploration.

BODY IMAGE

Garnett and Elbirlik (9) reviewed the developmental histories of nine torticollis patients and commented on the importance of body language and the nature of body image in this syndrome. Fisher and Cleveland (7) in a series of research studies have developed a measure of one aspect of body image; that of degree of definiteness of body image boundaries. This body image index, called the Barrier score, is derived from a content analysis of the Rorschach. The Barrier score comprises a count of all responses referring to objects with clear and well defined boundaries. Such Rorschach responses as "a cave with rock walls" or "a knight in a suit of armor" serve as examples. Psychosomatic patients with symptoms involving the body exterior, muscles and skin, were found to score unusually high on this index. In fact, a group of patients with conversion hysteria, of which eleven of the present control group were members, achieved among the highest

[3] I wish to express thanks to Drs. George Faibish, Seymour Fisher and Dale Johnson for serving as clinical judges.

Barrier scores of any group tested. Psychosomatic patients with body interior symptoms, duodenal ulcer or colitis, scored significantly lower on the Barrier index than did the conversion group. A normal sample tended to fall midway between these extreme groups. Pathologically high Barrier scores were found to indicate a frozen and immobile kind of body image. The immobile body image bears analogy to a fort with tremendous walls, which while protecting the individual from external threat also renders him imprisoned and incapable of expression.

Since torticollis is primarily a muscle symptom it was anticipated that these patients would score at least as high on Barrier as the conversion group and significantly higher than normal subjects or psychosomatic patients with interior symptoms. Table 1 presents a comparison of the Barrier score for the torticollis and conversion groups. It will be noted that torticollis patients tend to score even higher than the control group although not significantly so. Barrier score for both groups may be compared with data previously published (7) on normals and on a group with stomach symptoms. Patients with stomach complaints had a median Barrier score of only one, with a range of 0–5. Normal populations produced median scores of four, with a range of 0–10. Obviously, the torticollis sample exceeds both of these populations on Barrier score.

NECK SYMBOLISM

Garnett and Elbirlik (9) in their analysis of nine torticollis patients draw attention to the especial symbolic significance of the neck in our culture. Alexander (1), Halliday (12) and Murphy and Chasen (21) all emphasize the unusual symbolic meanings assigned to the neck by their torticollis patients.

In view of this general agreement concerning the magical role of the neck in torticollis, one might expect this concern to be reflected in unusual behavior on projective tests. For example, one would anticipate torticollis patients giving many neck responses on the Rorschach. Accordingly a count was made of all references in the Rorschach to the neck ("X-ray of the neck"; "natives with long necks") and a count of all animals with unusual necks ("giraffe"; "camel"). Reference to Table 1 indicates that neither torticollis or conversion groups made very many direct or indirect references to the neck. If anything, there is a slight tendency for the torticollis group to avoid neck references, since only five torticollis patients gave any neck responses at all, while half the conversion group gave one or more neck responses. However, this difference is not statistically significant.

Figure drawings were available for 14 of the torticollis group and the entire conversion sample. These were inspected for any unusual emphasis on the neck or other body distortions. In general there were no striking group differences. Three of the torticollis patients drew a picture of a man with torticollis; *i.e.*, the body in full view and the head turned in profile. One other torticollis patient remarked as he drew the figure, "He ain't gonna have much of a neck when I get through with him." Beyond this, the groups did not differ in their drawings in terms of relative size of the neck, adornment of the neck, or other unique body distortions.

HOSTILITY SCORE

Auerback and Gliebe (3), Murphy and Chasen (21), Whiles (27) and others have suggested that repressed hostility toward important figures in the past is frequently a motivating force in the torticollis symptom. Mendelson (18), for example, reports a patient whose torticoilis represented a turning to God and an offering of prayer as a replacement for strong hostile feelings. Of course the management of repressed hostility is not unique to torticollis. Conversion symptoms of any nature are likely to be attended by strong underlying hostility. Accordingly, it was not anticipated that the

control and experimental groups in the present study would differ on hostility measures. Rather, it was predicted that both groups would have high hostility scores in comparison with a normal population or other kinds of psychiatric groups.

There are several different scoring schemes available for estimating the prevalence of hostile feelings in a Rorschach record. This writer was already familiar with Elizur's (5) system for scoring hostile content. In this system any Rorschach response involving direct hostile expression ("a gun"; "two men fighting") is given a score of two. Symbolic or indirect hostility is given a score of one ("gossiping women"). Elizur and others have demonstrated that high hostility scores on this scale are related to potential for hostile outburst and display.

The Rorschach records of the 17 torticollis and 20 conversion cases were scored in this manner for hostile content. The results listed in Table 1 indicate that the conversion and torticollis groups have nearly identical hostility scores. Elizur has reported a mean hostility score of 5.6 for a neurotic population composed of men and women and a mean score of 1.3 for a normal sample. In the present study the torticollis mean hostility score is 5.2 and the conversion group mean identical with the median score of 5. Obviously the psychiatric groups do not differ from one another, but all score significantly higher than a normal group.

GUILT AND SHAME

Auerback and Gliebe (3), Garnett and Elbirlik (9), Mendelson (18) and Whiles (27) have all commented on the strong feelings of guilt and shame present in the torticollis cases examined by them. Guilt is seen as a function in part, of the repressed hostile feelings previously described. In part, guilt may stem from past transgressions, real or fantasied. Garnett and Elbirlik also make the interesting point that the torticollis patient feels shame for surrendering to his own impulses and temptations or to being witness to the surrender of others. Presumably the torticollis symptom represents a dramatization of these feelings, a tableau in which guilt and shame are acted out.

In the present study it appeared that the TAT stories offered the best opportunity to compare the prevalence of guilt fantasies in torticollis patients vs. the conversion group. In order to identify more precisely the guilt themes and their reference object, only those stories involving a relationship to parental figures were analyzed (Cards 1, 2, 5, 6BM and 7BM). Stories relating guilt for not

TABLE 1

Comparison of Barrier Score, Neck Symbolism, Hostility, Guilt, Looking and Time Themes, for the Torticollis and Conversion Groups

Group	Descriptive Measure	Barrier Score (Rorschach)	Neck Symbolism (Rorschach)	Elizur Hostility (Rorschach)	Guilt Themes (TAT)	Looking (Rorschach)	Looking (TAT)	Time & Age (Rorschach)	Time & Age (TAT)
Torticollis (N = 17)	Median Score	5	0	5	3	2	6	2	2
	Range	1–10	0–4	0–14	1–5	0–8	1–15	0–5	0–5
	% Scoring above combined group median	10	5	7	11	13	10	13	8
	X^2	1.3	1.9	—	12.8	8.7	3.8	8.7	3.1
	P(df = 1)	—	—	—	0.001	0.01	0.05	0.01	0.05–0.06
Conversion (N = 20)	Median Score	4	0	5	1	0	2	0	1
	Range	1–7	0–3	1–10	0–4	0–3	0–5	0–2	0–3
	% Scoring above combined group median	8	10	10	5	7	7	7	5

having lived up to parental expectations, guilt for not having met one's obligations or having failed parental standards were included under this category. Another aspect of this same theme were stories depicting the main character as having accomplished something in a sneaky and underhanded way, or having fooled the parent. This latter theme would be illustrated by the following story given by a torticollis patient to Card 1, depicting a small boy and violin. "He is supposed to take violin lessons but don't want to. He is wondering how to get out of it. If mother is close by he will have to take lessons, but if she is out he will skip them." The following story by another torticollis patient given to Card 6BM, a young man and older woman, illustrates the theme of guilt over failed obligations. "Gray haired mother has turned her back on him. She had great hopes for him. The son has done something very wrong, he is embarrassed." Each of the five TAT cards involved in this analysis were examined for presence of a theme implying guilt and shame on the part of the central figure. When the stories of both subject groups had been analyzed in this manner, it was readily apparent that the hypothesis concerning the importance of feelings of guilt and shame in torticollis patients had been substantiated. Reference to Table 1 indicates that at least half of the torticollis group included three or more guilt themes in their stories while the median number of guilt themes for the generalized conversion sample is only one. This difference in frequency of themes easily attains statistical significance.

LOOKING

Most of the previously mentioned authors refer directly or indirectly to the importance attached by the torticollis patient to the act of looking. Some writers draw attention to the possibility that the turned head represents a looking away from painful or intolerable problems or adult responsibilities. Other investigators suggest the looking is directed toward something tempting yet forbidden. In any event there does seem to be a consensus concerning the torticollis patient's tendency to attach unusual and magical properties to the eyes and the act of looking.

In order to test the relative frequency of occurrence of these kinds of fantasies, the Rorschach records of both subject groups were examined for all responses having to do with the act of looking. The following are some of the kinds of responses so scored: "A pair of eyes in a spider's web"; "A microscope to see through"; "A man hidden in a duck blind"; "A science fiction man with beams of light shining from his eyes." It was predicted that the torticollis group would exceed the conversion sample with these kinds of responses. In Table 1 results of this tabulation are presented. In line with the prediction, the torticollis patients exceed the control group on this variable.

A similar analysis was made of all the TAT stories. In this case all references to looking, the eyes and communication by visual means were scored. For example such statements in a TAT story as the following were noted: "That little boy is blind"; "She is giving him a penetrating look"; "That's a scene of violence"; "He is looking around to see if anyone is looking, if he will be caught"; "That woman is an overseer." In this analysis each statement and reference to the eyes or to an act of looking on the part of a TAT story character were scored. Accordingly, some stories had several such references and the total score on this measure could exceed the number of stories involved. It was anticipated that the torticollis patients would exceed the conversion group with these references. The results listed in Table 1 support this prediction.

TIME AND AGE

Not much has been said about what it may be that the person with torticollis looks away from or toward other than in a general sense of something tempting or forbid-

den. Reviewing the projective test records of the torticollis cases, this writer was impressed by the unusual frequency with which these patients inserted references to time, aging and the use of time as a reference point. This preoccupation with the passage of time can best be summed up by describing their fantasies elicited by the Rorschach and TAT as having a distinctly nostalgic quality. It was felt that this unusual emphasis on the past must have some unique relationship to the torticollis patient's conflict.

In order to demonstrate more objectively this impression concerning the matter of time and age for the torticollis group, the Rorschach and TAT records were examined for frequency of these references. In the case of the Rorschach protocols, a count was made of all responses directly or indirectly referring to an object as old, ancient or old-fashioned. For example, such responses as "an old time saloon door," "an old-fashioned lamp post," "a pre-historic animal" and "an old dog, because he has a wrinkled face," were included in this scoring. Scored also were responses of the following type indicating a passage of time: "turning leaves like in the Fall"; "a flower, like a forget-me-not."

The final score on this measure consisted simply of a count of all such responses. The results listed in Table 1 indicate that the clinical impression concerning the unusual frequency of these responses in the torticollis group was supported.

The TAT stories were also examined for all themes having to do with nostalgia for the past or reference to the past as a way of life or a reference point. Examples of themes and references to the past scored under this category are the following: "The man is a hard working farmer like his folks centuries before him"; "That's an old time scene in the 1600's"; "The boy is looking at the violin immediately after the funeral of his brother who used to play such sweet music. He realizes those days are gone forever, and the violin is only one of his brother's many remembrances"; "She looks back at her many moods in the summer past"; "That boy looks like Abraham Lincoln studying by candlelight." Not so scored was simple reference to someone being old, such as a story beginning, "That's an old man and a young man."

These references to the past and to things aged are unusual and infrequent responses. Neither the torticollis nor the conversion group gave a profusion of such responses. However, the results listed in Table 1 show that there is a definite tendency for the torticollis group to include these references more frequently in their TAT stories than does the control group. In this case the difference between the groups barely reaches a level of statistical significance. Coupled with a similar trend on the Rorschach, however, the pattern of such responses clearly favors the torticollis group.

JUDGES' RATINGS

Three psychologists enumerated on a blind basis the fantasy themes and personality conflicts most obvious to them in perusing projective test records of five torticollis cases. All three judges commented on the unusual themes concerning time and age, while placing somewhat differing emphasis on the interpretation of these themes. Themes of guilt and shame were also noted by the three judges as well as the unusual degree of hostile content. One judge concurred with the author in noting the prevalence of fantasies invoking the eyes and the act of looking. Overall the degree of concurrence on a blind basis and interpreting projective test material out of context was satisfactory and encouraging as to the objectivity of the major personality themes represented.

DISCUSSION

Summing up the psychological test findings pertaining to the torticollis group, we find no unusual degree of attention paid n

human figure drawings or in Rorschach content to the primary symptom of torticollis, the neck. However, a part of the body directly and intimately related to the head and neck is given unusual importance in the projective material—the eyes and the act of looking. A reservoir of ready hostile feelings, a frozen and immobile type of body image, especial fantasies relating to guilt and shame and a nostalgic orientation to the past, complete the pattern of personality dynamics characterizing the torticollis group that emerges from the present study.

At first glance, it is puzzling that the neck does not receive more attention in the fantasies elicited from torticollis patients by psychological tests. This writer has no ready explanation for this omission, although it may be that this is an entirely too simple and obvious a correlation to expect. The relationship between physical appearance and the psychological meaning of that appearance is complex and often even surprisingly diverse. For example, Silverstein and Robinson were unable to distinguish the figure drawings of normal children and those with residual paralysis due to poliomyelitis. They observe (25, p. 340), "The present study and other similar investigations have rested on the assumption that the physical body, the body image, and the drawn figure are in isomorphic relation. Given careful exploration, this one to one relationship does not seem to exist."

Perhaps the most unusual and intriguing aspect of the unconscious fantasies of the torticollis group, concerns preoccupation with antiquity and the concept of time. A heavy, sentimental nostalgia for the "good old days" seems to be a prominent characteristic of a majority of the TAT and Rorschach records. Coupled with the unusual concern attached to the eyes and the act of looking, one is tempted to speculate that one meaning contained in the torticollis act is an almost literal turning back, a backward glance to the past, to earlier relationships and earlier life problems. This backward glance cannot be accomplished without conflict, however. For we note in the TAT material feelings of guilt and shame characterizing the relationship with early family figures. The torticollis patient struggles with his sense of unfilled obligations. He is pulled or pushed forward in one direction by the demands and expectations of parents and society. But he also harks back to earlier times and standards as he seeks to avoid these same responsibilities and demands.

It is interesting to note that a taboo of nearly universal proportion surrounds the backward glance into the past. One can only look back under threat of punishment. For example, there is a superstition in many different cultures that it is bad luck to look back when departing a place or person. In Greek mythology the familiar story of Orpheus and Eurydice repeats this theme. In this myth Orpheus is granted a new life with his bride on condition that he not look back at her as they leave the underworld. Punishment follows swiftly Orpheus' forbidden turn to look back at Eurydice as they are leaving Hades, and she is then forever consigned to the underworld by the gods.

In the Bible, Lot's wife is turned into a pillar of salt when, although forbidden to do so, she looks back on the cities of Sodom and Gomorrah as she and her husband are leaving. It is by no means clear as to why this curious taboo surrounds the backward glance, although Melville (17, p. 188) may have put his finger upon the primary meaning inherent in these myths. Decrying the barbaric conditions of the past surrounding the treatment of men on board sailing vessels, he has this to say of individuals or institutions that cling to tradition. "The Past is in many things, the foe of mankind . . . In the Past is no hope . . . Those who are solely governed by the Past stand still like Lot's wife, crystallized in the act of looking backward, and forever incapable of looking before."

Poets, novelists and philosophers have had much more to say about the subjective

meaning of time than have scientific theorists. Nearly every writer of any stature at all has at least commented in passing on the subjective experiencing of past, present and future. Writers such as Wolfe, Proust, Joyce and Melville as well as many others have devoted lengthy works to man's desperate search of his past in order to assign meaning and identity to his own existence. The thesis is presented convincingly that for many in our contemporary culture the present and future holds little meaning. Current values of achievement and material production, tremendous pressures to compete and produce in the market place, devaluation of the family and the individual all combine to reduce the individual's sense of identification. In desperate search for identity such a person is likely to turn to the past in search of meaning to his life and as a means of avoiding the demands and pressures of the moment. Meyerhoff (20, p. 113) analyzing the concept of time in modern literature has eloquently presented this thesis as follows.

"If the value of time is measured by what is produced and consumed, and if the individual's life is envisaged as nothing but an accumulation of these socially useful moments of time, the status of the self is obviously threatened. Instead of being endowed with intrinsic value, the self is of purely instrumental, technological value, just like any other commodity.... To say that the moments of time are of purely instrumental value, like the units of production, easily leads to the notion that the accumulation (or bundle) of such moments and fragments constituting the life history of an individual also is of purely instrumental, and never of intrinsic, value. Man himself becomes primarily a productive unit along the assembly lines of society... He is worth what he is worth here and now... man's worth is invariably measured by what he has done or in capable of doing, rather than by what he is."

Faced with such feelings of isolation and demands of the moment, the individual may turn to the past for solace as Meyerhoff again points out. "... the frequent, intense search for a recapture of the past, one's own, the family's, the nation's or mankind's may be seen as an attempt to recover oneself by discovering this sense of continuity with and belongingness to something that seems forever lost."

It is this writer's conviction that the relevance of the preceding thesis for the torticollis group may be more than coincidental. The torticollis patient struggles, in fantasy at least, against parental expectations of achievement and success. He feels obligated to parents who set certain standards and values but he feels that he has failed to meet these standards. By and large his feelings of shame and guilt as elicited by the TAT are focused on parents who placed great value on personal gain and achievement. One can speculate that among the commodities ranking high in value for the achievement oriented parents was the concept of time. Time could either be used profitably by producing something or time could be wasted by doing nothing, by just drifting. The torticollis patient is torn between these conflicting poles. On the one hand he feels pushed by parents and by a demanding society to accomplish something. But he fails to identify with this spirit of individualism and he turns for identification to traditions in the past which he hopes will provide more value and purpose. Just how strongly the individual in our society feels pressed by time has been dramatically noted by Mendilow (19, p. 10). Commenting on the obsession with time in the twentieth-century novel he writes as follows.

"The keynote of modern existence is speed... It is significant that speed originally had the meaning of success; western civilization measures success today by the increase in the rate of movement towards some spatial point or towards some goal we set up before us. Achievement is estimated

in terms of the length of time taken to accomplish our purposes, for time is money, and in a changing universe we have no time to waste or lose . . . Life seems to be resolving itself into a feverish scramble for the last drinks before the inexorable barmaid calls out her fatal 'Time, gentlemen, time' and shuts up shop for good."

Erikson (6) has formalized this seeking for identity in a theoretical system in which he outlines the social, historical and political values implementing formation of what he terms the "American identity." Of interest to the present study are his observations on the role of tradition and the standards of the past in the forming of one's identity. He suggests that some individuals, unable to come to terms with demands of what he calls our "machine age," turn back to figures of the past, perhaps a pioneer grandfather, as a source of identity. In contrast to the torticollis patient's unsuccessful and ambivalent search for the past, Erikson contends that this utilization of the past serves as a positive anchoring point.

There is one group of individuals who are encouraged to search the past for reasons that in the long run prove to be positive and constructive. Reference here is made to persons in psychoanalysis whose primary responsibility in treatment is a conscientious search of their past. Erikson (6, p. 378) points out that even here some analysands, like the torticollis patient, remain frozen to the past and fearful of looking forward. "Psychoanalysts, in their daily work, are consulted by those who cannot stand the tension between polarities, the never-ceasing necessity of remaining tentative in order to be free to take the next step, to turn the next corner. Many patients hope to find in a psychoanalytic 'system' a magic refuge from the discontinuities of existence; treatment itself becomes a regression to a better ritualized, more homogeneous, more patriarchial one to one relationship. . . . The cured patient has the courage to face the discontinuities of life in this country and the polarities of its struggles for an economic and cultural identity. . . ."

Time also has for the torticollis patient a destructive connotation. There is implied the fear that time is running out and the wish that the march of time could be slowed. With the passage of time comes deterioration, especially of the body. The torticollis patient turns away from advancing age, from dissolution of his body and the ultimate fear of death. He turns toward fantasies of youth and health. In this respect the torticollis patient shares much in common with certain persons seen in analytic practice by Greenson (11, p. 243). He describes a group of patients with what he refers to as "screen identity." These patients utilize time itself as a screen to hide from current responsibility, and turn away in fantasy from a consideration of the onward rush of time. "These patients have a rather distinct relationship to time . . . When they recount a past event they tend to relive it without recognizing even afterwards the passage of time that has taken place since the actual experience occurred. Their closeness to the past gives them a youthful quality and their self-picture is many years younger than their chronological age. Though they dread old age, death is unreal to them; they tend to believe in their immortality."

Finally it should be noted that schizophrenic patients tend to resolve the problem of time relationship by waving it aside. For example, Balken (4) analyzed the TAT stories of a schizophrenic group for references to time, past, present and future. She found that as a group they tend to obscure any distinction among these reference points in time and to treat everything in an "I - here - now" relationship. She concludes, "The schizophrenic does not distinguish between the past, the present and the future, between the real and unreal—and thus becomes a prey to the inertia of the past."

The nature of the relationship between one's subjective meaning of time and cer-

tain personality variables has recently been explored in a series of intriguing research reports. A team of investigators headed by Atkinson and McClelland (2) has identified an important personality factor termed the achievement motive. This concept refers to the degree to which an individual adopts a life philosophy centered around striving for achievement and success, coming to grips with one's environment, being a manipulator of the environment. Green and Knapp (10) find time judgment, esthetic preference and need for achievement to be significantly and positively related. Subjects with high achievement motive perceive past events as much less remote than they actually are. These same subjects express esthetic tastes of a conservative and traditional nature. Knapp and Garbutt (16) also found that high achievers conceive of time in such terms as "active, fast and hasty." These researchers point out that in these instances successful achievers (in a normal population) view time as a challenge, as something which provides the necessary conditions for success to occur. These investigators reason that to see the past as close to the present is to feel that, "the past has not yet slipped away, and the universe that confronts (one) is therefore teeming with opportunities for manipulation and achievement." How different is the case with the torticollis group. For reasons not yet clear, these persons also cling to the past and to tradition but more for purposes of escape and avoidance of achievement and success. McClelland's group finds that parents of achievers train their children in independence and achievement by rewarding achievement, non-punishing failure and by placing few restrictions on opportunity for achievement. One would speculate that parents of torticollis patients somehow introduce conflict into this triad of motivating forces so that the child is both pushed forward while being pulled backward by the parent.

Obviously the present study raises more questions than it attempts to answer in examining some of the unconscious fantasies of torticollis patients. Certain hypotheses concerning the relationship between the symptom of torticollis and the patient's subjective meaning and concept of time are suggested. Unanswered is the crucial question as to why a conflict over life's responsibilities and demands is dramatized in an antagonistic muscle response. Data available in this study were necessarily limited and only a more ambitious study employing in addition psychiatric and social information can approach this question.

SUMMARY

Seventeen male veterans diagnosed as torticollis, conversion reaction, were administered the Rorschach, Draw-a-Person, and TAT. Twenty male veterans also diagnosed as conversion reaction but with symptoms involving parts of the body other than the head and neck were similarly tested.

The two subject groups were compared in terms of their projective test records on the following personality variables: 1) Body image; 2) Neck symbolism; 3) Hostility; 4) Fantasies of guilt and shame; 5) Looking fantasies; 6) Concern with time.

Both groups scored high on the Cleveland-Fisher body image index, with the torticollis patients being characterized especially as having a frozen, immobile body image. The groups do not differ in respect to neck symbolism. The torticollis sample significantly exceeds the general conversion group in production of fantasies featuring guilt and shame and emphasizing the eyes and the act of looking. The torticollis patients also exceed the conversion group in their concern with the past and the passage of time.

This pattern of findings suggests that among the conflicts contributing to the torticollis patient's dilemma are those centering about responsibilities and demands made by ambitious parents and a materialistic society. Recent experimental work demonstrates a relationship between achievement motive and attitude toward

time. Successful achievers view time as a challenge but the torticollis patient appears dismayed by time and searches the past for solace.

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THE FORMATION AND EXTINCTION OF CONDITIONED REFLEXES IN "BRAIN-DAMAGED" AND MONGOLOID CHILDREN

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The terms "brain-damaged" or "brain-injured" when applied to children refers to a combination of psychologic functions that are presumed to originate in pre-natal, perinatal or infantile insults to the cerebrum. The category is entirely behavioral (4, 5) and implies that any of a number of kinds of cerebral damage will result in a common pattern of behavioral disturbance. Locus of injury, nature of the lesion and the temporal course of the illness are usually not considered in the designation, and the non-behavioral, neurologic confirmation of the fact of anatomic insult has been conspicuous by its absence. These considerations make it clear that the term "brain-damaged" refers to a behavior syndrome and not to the fact of brain damage as such.

The identification of a pathological pattern of behavior, characterized by difficulties in figure-ground perception, abnormal distractibility, perseverative tendencies, conceptual rigidity, emotional lability, and hyperactivity, by Strauss and Werner (4–16) was an important contribution to the more refined differential diagnosis and treatment of psychologically disturbed children. However, the unfortunate characterization of the pattern as *the* "brain-damaged child" has led to confusion in two directions. First, Strauss (5) has declared that the syndrome is pathognomonic of brain damage and has assumed behavior problems to have such an etiology even in the absence of any clearly substantiating neurologic or historical data. Second, it has come to be widely assumed that the behavior syndrome described is the typical consequence of organic brain damage in childhood. Neither of these extensions appears to be warranted by experience. In earlier discussions (1, 2) one of us has pointed to a variety of patterns of behavioral alteration that may occur as the consequence of organic brain damage in infancy and childhood and has argued that the syndrome described by Strauss and his colleagues represents only one of many different types of behavioral alteration that may be associated with cerebral lesions in children. However, to define the numerous distinct behavioral syndromes which may occur as consequences of infantile cerebral damage is beyond the scope of the present report. It is concerned, rather, with a more limited and specific inquiry into the behavioral sequellae of brain damage. Basic to the present study is the view that a population of children who are known to have cerebral injury may, at the very least, be divided into two groups, one of which contains children who exhibit hyperactivity and/or distractibility and a second whose members do not show either of these characteristics. Possible underlying differences in the central nervous system organization in each of these groups can then be analyzed through the use of both psychologic and physiologic techniques.

The use of conditioned reflex methods for such analysis seems especially desirable since conditioned reflex theory (3) permits the formulation of some quite specific hypotheses concerning the nature of the functional alterations in central nervous system activity that may underlie hyperactivity and distractibility, two prominent and readily discerned features of the behavior

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occurring in some of the children who have sustained cerebral damage. From the point of view of Pavlovian theory the behavioral phenomena of distractibility, hyperactivity and even of perseveration can be conceptualized as manifestations of defective equilibration between the processes of cortical excitation and inhibition. If this conceptualization is correct, one should find differences in the character of the processes of cortical excitatory and inhibitory activity in normal and hyperactive groups. For this reason the present study is concerned with a comparative examination of the conditioning and extinction process in hyperactive and/or distractible brain-damaged children and in brain-damaged children who exhibit neither hyperactivity nor distractibility. It includes as well an analysis of the functioning of a sample of mongoloid children and of a small number of normal children.

METHOD

SUBJECTS

In examining the records of children in a pediatric psychiatric installation, it was possible to obtain records of eighteen children who showed unequivocal evidence of central nervous system trauma acquired either perinatally or as a consequence of meningitis or encephalitis in infancy. Supportive evidence included the presence of seizures, and/or of neurological signs such as pathologic reflexes and abnormal EEG. The presence or absence of stereotyped behavioral characteristics was not used as a variable in the selection. The sex, I.Q. and age of the subjects are presented in Table 1.

Behavioral analysis of these 18 children showed that ten of them were hyperactive and/or distractible, whereas the remaining eight included six normoactive and two hypoactive children. For comparative purposes eight mongoloid children with no history of central nervous system trauma, and four normal children who were convalescing from non-neurologic illness were studied.

APPARATUS AND PROCEDURES

The unconditioned stimulus used was a mild electric shock adjusted by means of a Variac supplied by a 120 volt, 60 cycle AC source. The shock was administered through two polished copper electrodes which were

TABLE 1

Classification, Sex, Age and I.Q. of Subjects

Brain-Damaged								Mongoloid			
Non-H and Non-D				Hyperact. and /or Distract.							
Subj.	Sex	Age	I.Q.	Subj.	Sex	Age	I.Q.	Subj.	Sex	Age	I.Q.
J.E.	M	8–5	85	S.P.	F	10–5	85	E.P.	F	6–2	68
J.J.	M	10–2	68	L.G.	F	8–6	80	L.L.	M	6–2	67
S.B.	M	15–1	60	A.M.	F	13–2	63	A.S.	F	9–8	54
S.S.	M	12–2	55	C.H.	F	12–10	60	L.D.	F	8–5	48
J.S.	F	16–9	51	M.S.	F	10–6	60	L.C.	M	6–9	38
B.W.	M	17–5	50	C.C.	M	12–4	57	C.K.	F	15–0	36
J.M.	M	12–10	48	V.M.	M	13–1	54	B.H.	F	13–0	35
R.A.	M	15–1	42	S.H.	M	10–8	54	G.H.	F	11–7	33
				W.B.	M	15–11	49				
				W.W.	F	14–0	30				
Mean I.Q.*			57.4				59.2				47.4
S.D.			12.8				15.3				13.4

* There is no statistically significant difference between the mean I.Q.'s of these groups.

taped to the inside of each forearm. A 7½ watt white frosted bulb served as the conditioned stimulus. It was placed on the wall five feet in front of the subject, who was seated in a cushioned chair provided with broad wooden arm rests. Continuous recordings of the skin resistance were taken by means of a C.E.M. Research Laboratories Physiological Recording Galvanometer, model #650. Extraneous visual stimuli were minimized, but no control over auditory stimuli was maintained.

Since any new stimulus can affect the GSR, at the beginning of each child's first session the light was presented alone for approximately 1½ sec. once every 30 sec. This was done until there was no measurable response to three consecutive presentations of the light. Then the intensity of the shock was built up to a level which resulted in a decrease in skin resistance equivalent to an increased current flow of at least 0.039 milliamperes. This amplitude was chosen because it was of greater magnitude than 90 per cent of the observed random fluctuations in skin resistance. After the desired level of shock was attained, the light alone was again presented every 30 sec. to the criterion of three consecutive zero responses, in order to eliminate the possibility of "pseudo-conditioning," *i.e.* the creation by shock alone of a hypersensitive nervous system which could produce a high level of response to any subsequent neutral stimulus. In no case were the responses to the light alone following the determination of the proper shock level of sufficient duration and amplitude to warrant the possibility that the criterion for conditioning could be reached without true conditioning taking place.

Following a second extinction of the skin response to the light the conditioning series itself was started. This consisted of alternate presentations of the light and shock in combination and then light alone. The interval between each step in the sequence was 90 sec. so that any two successive presentations of either light alone or of the light shock combination occurred at three minute intervals. When the stimuli were paired, the onset of the light would precede the shock by ½ sec. and would be present for a total time of 1½ sec.

The alternate presentations of light paired with shock and light alone continued until there were three successive responses to the light alone which were either equal to, or greater than 0.039 milliamperes in amplitude. The extinction series began ninety seconds after the third consecutive CR. For the extinction series, the light alone was presented every 90 sec. until three consecutive zero responses to this stimulus were produced.

In the majority of cases the entire process could not comfortably be completed in a single session. Therefore, each experimental period was limited to one hour. The only exception to this rule occurred after the conditioning criterion had been reached and the extinction series was initiated. Since extinction was sometimes prolonged, the final session lasted for between one and two hours.

RESULTS

QUANTITATIVE FEATURES OF THE C.R. FORMATION

When the course of conditioning is examined, it is found (Table 2) that the hyperactive and/or distractible group of brain damaged children required a significantly greater number of trials ($p = .02$) to reach the criterion of conditioning than did the non-hyperactive and non-distractible brain damaged group. The mean number of trials required was 31.2 for the hyperactive and 10.6 for the non-hyperactive children. In only one case is there any overlap between the number of trials required to reach conditioning by the individuals in the two groups. It is of further interest to note that whereas it was possible to complete the conditioning of all the non-hyperactive chil-

TABLE 2

Number of Presentations of Light Paired with Shock Necessary to Reach Criterion for Conditioning

Brain-Damaged						Mongoloid		Normal	
Non-H and D		H and/or D							
		Completed Inc.							
Subj.	No. of Trials	Subj.	No. of Trials	Subj.	No. of Trials	Subj.	No. of Trials	Subj.	No. of Trials
J.J.	4	A.M.	13	S.P.	31+	C.K.	4	D.T.	4
J.M.	7	W.B.	19	C.H.	37+	G.H.	4	S.S.	5
S.S.	8	W.W.	21	M.S.	40+	L.D.	19	B.A.	6
J.E.	9	V.M.	30	L.G.	78+	A.S.	25	E.R.	10
J.S.	9	C.C.	48			B.H.	36		
B.W.	14	S.H.	56			L.L.	40		
R.A.	17					E.P.	45		
S.B.	17					L.C.	91		
Mean	10.6		31.2				33.0		6.3
S.D.	4.5		15.5				26.5		2.3

The scores of the subjects who did not reach the criterion for conditioning are indicated by a + and were not included in the calculation of the means.

t Scores and Corresponding Probability Values that the Null Hypothesis Regarding the Differences between the Mean Number of Presentations of Light Paired with Shock Necessary to Reach Criterion for Conditioning Can be Rejected

	H and/or D		Mongoloid		Normal	
	t Score	*p* Value	*t* Score	*p* Value	*t* Score	*p* Value
Non-H and Non-D	2.87	2%	2.20	5%	2.03	10%
H and/or D			0.15	50%	3.53	1%
Mongoloid					2.64	5%

The p values were calculated by using Fisher's t for small samples.

dren, 40 per cent of the hyperactive children could not achieve criterion levels of conditioning despite prolonged training periods.

The mongoloid group, performs significantly more poorly than does the non-hyperactive and non-distractible brain damaged group ($p = .05$). The mongoloid children require approximately the same number of trials to achieve the conditioning criterion as do those of the hyperactive and/or distractible subjects who could be conditioned. It is possible that this elevation in number of trials required by the mongoloid children is largely the contribution made by the three youngest children of the group, all of whom were under seven years of age. If these young children are eliminated from consideration the conditioning of the remaining mongoloid children tends to become significantly more efficient than that of the hyperactive and/or distractible children, who were conditionable.

When the performance of the four normal children are analyzed it is found that they required significantly fewer trials to reach the criterion for adequate conditioning than either the hyperactive and/or distractible ($p = .01$) or mongoloid group ($p = .05$). However, they do not condition at a level which is significantly different from the performances of the non-hyperactive and non-distractible subjects ($p = .10$).

In order to determine whether the differences among the retarded children with respect to conditioning rate is in any way a reflection of differences among these children with respect to intellectual capacity as measured by I.Q., a correlation was made between these two variables. The product-moment correlation was $r = -.07$, which suggests that for the children in this study the I.Q. and the formation of the conditioned reflex are independent measures. Thus, for the children in this study the measure of the number of reinforced trials necessary for conditioning is not merely another means of demonstrating those consequences of brain damage which may be reflected in a modified I.Q.

QUALITATIVE FEATURES OF THE C.R. FORMATION

There were marked differences in the behavior of the children of the different groups during the conditioning series. The two groups of brain-damaged children showed the most extreme differences in behavior. The group of hyperactive and/or distractible children could only cooperate for a short time. Their capacities to sit still, to concentrate on one stimulus, to refrain from talking and to ignore the temptation to manipulate the electrodes were all limited. Moreover, as the session wore on this behavior became pronounced and occurred more and more frequently. The type of increased activity varied from child to child. Some chose to talk to the experimenter. According to the level of functioning of the child the talking ranged from coherent statements and questions in an attempt to engage the experimenter in conversation to apparently incoherent and disconnected verbalizations. Two children chose to sing and whistle during the sessions.

Other of the hyperactive children resorted to an increase in gross motor activity, either of the entire body or of parts, such as slapping their hands against the arm rests or kicking their feet against the floor. Still others would try to manipulate objects within reach such as the door latch or the wire leading to the bulb. Additional distractions were auditory stimuli from outside of the experimental situation many of which were of such low intensity that the experimenter was not aware of them until the child would call his attention to them by asking, "What's that?" These children tended to resort to several activities, but each seemed to have his or her characteristic preferred activity which increased progressively during a given training session.

The non-hyperactive and non-distractible group of brain-damaged children provided a distinct contrast to the hyperactive and/or distractible group. Although they were not entirely at ease in the experimental situation, a small amount of restlessness was all that was exhibited. In no case did this restlessness tend to increase during the initial session or to recur in the second session when more than one training period was required.

The mongoloid group varied slightly in the amount of motor activity and distractibility exhibited. With only one of the children however, was there any excessive restlessness, talking, increase in activity, or distractibility. This one mongoloid child (L. C.) was restless and extremely distractible and required an unusually long series of reinforcements before the criterion for conditioning was reached. L. C. was perhaps the most distractible subject used in this experiment in that he would respond to all extraneous auditory stimuli (including some that were almost inaudible to the experimenter) by asking what it was. This type of behavior was very similar to that encountered in the group of hyperactive and/or distractible brain-damaged children and gives one the impression that L. C. may have been such a child.

Of the four normal patients tested, none exhibited excessive motor activity.

EXTINCTION OF THE CONDITIONED REFLEX

When the quantitative features of extinction are explored (Table 3) it is found that no significant difference in mean number of trials required to achieve extinction exists among the three retarded groups. However, a qualitative consideration of the course of events during the extinction series serves to distinguish the groups of children from each other.

Extinction in the hyperactive group was characterized by a progressive increase in extraneous activity of the children and appeared to be the result of a displacement of the conditioned reflex by external extinction through the development of adventitious movements. In the group of non-hyperactive brain damaged children extinction pursued a classical course, with no progressive increase in restlessness occurring. In the mongoloid group and in the normal children the extinction series resulted in the progressive increase in inhibition, with four of the eight mongoloid children and two of the four normal children falling sound asleep during this session (Table 3). One of the mongoloid children slept for such a long period of time (more than three minutes) during the series

TABLE 3

Number of Presentations of Light Alone Necessary to Reach Criterion for Extinction

Brain-Damaged					Mongoloid			Normal		
Non-H and D		H and/or D								
Subj.	No. of Trials	Subj.	No. of Trials	No. of Trials to Sleep	Subj.	No. of Trials	No. of Trials to Sleep	Subj.	No. of Trials	No. of Trials to Sleep
J.J.	33	A.M.	32*	12	C.K.	35		D.T.	41*	32
J.M.	36	W.B.	20		G.H.	13*	5	S.S.	43+*	15
S.S.	8	W.W.	31		L.D.	27		B.A.	48+	
J.E.	27	V.M.	28		A.S.	14		E.R.	22	
J.S.	31+	C.C.	4		B.H.	29*	29			
B.W.	26	S.H.	20		L.L.	61+*	5			
R.A.	9	S.P.	—		E.P.	22*	21			
S.B.	12	C.H.	—		L.C.	21+				
		M.S.	—							
		L.G.	—							
Mean	21.6		22.5			23.5	15.0		25.0	23.5
S.D.	10.8		9.6			9.9	10.3		11.5	8.5

* Indicates that sleep occurred during the extinction period.

The scores of the subjects who did not reach the criterion for extinction are indicated by a + and were not included in the calculation of the means.

t Scores and Corresponding Probability Values that the Null Hypothesis Regarding the Differences between the Mean Number of Presentations of Light Alone Necessary to Reach Criterion for Extinction Can be Rejected

	H an/or D		Mongoloid	
	t Score	*p* Value	*t* Score	*p* Value
Non-H and Non-D	0.152	50%	0.160	50%
H and/or D			0.314	50%

The *p* values were calculated by using Fisher's *t* for small samples.

that the extinction criterion was met by the sleep itself. Among the normal children, one child fell asleep for brief periods at five distinct points in the extinction sequence.

When sleep occurred there was a slow, steady, increase in skin resistance which persisted until the subject awoke. Upon awakening, there was a sharp decrease, of variable magnitude, in skin resistance. This course of events was peculiar to the sleeping children. In every case the experimenter observed the subjects while they were asleep in order to further verify that sleep had occurred. In all instances the subject could be seen in the completely relaxed posture characteristic of one who is asleep, with closed eyes and head resting on his or her chest or arm.

In contrast to the pattern just described the extinction series behavior of the hyperactive and/or distractible children was unmarked by any diminution of activity levels. The pattern of restlessness and high level mobility was sustained throughout the course of the extinction series.

DISCUSSION

The results of the present study are best understood if the acquisition and the extinction of the conditioned reflex are considered separately. This is especially true since some of the findings concerning the formation or failure of formation of the conditioned galvanic skin response are illuminated by an independent consideration of the events that occurred during the subsequent extinction series.

The formation of a conditioned reflex involves the establishment of functional equivalence between two stimuli one of which is initially neutral and the other initially effective in producing the response. In normal children the neutral stimulus rapidly becomes a focus of attention and after a variable number of presentations which overlap in time with the administration of the effective stimulus, conditioning results. This classical course of events does not occur in our hyperactive-distractible children, in 40 per cent of whom we were unable to establish a definite conditioned reflex. Attention was rarely focused and responses were made to a miscellany of situational aspects. This lack of selectivity in attention may be interpreted as a manifestation of a defective process of inhibition, with the relevant stimulus incapable of achieving dominance and so reducing the effectiveness of explicit sensory arousals. Children in the non-hyperactive brain-damaged, mongoloid, and normal groups do not exhibit this type of difficulty.

The data on the extinction of the conditioned reflex support the view that a defective equilibrium between excitatory and inhibitory relations characterizes the hyperactive and distractible brain-damaged group. A brief statement of general conditioning theory is necessary in discussing the extinction data. Pavlov has advanced two concepts to account for the disappearance of a conditioned reflex, internal inhibition and external inhibition. Internal inhibition refers to the progressive development of inhibitory activity at a cortical locus which occurs in response to the continued unreinforced presentation of the conditioned stimulus. External inhibition refers to the process whereby the presentation of extraneous stimuli may by interference function to make the conditioned stimulus ineffective. The first of these postulated mechanisms appears to be an analogue of adaption, and the second of displacement. Among the subjects in the present investigation the hyperactive-distractible group appear to lose the conditioned reflex by external inhibition or displacement, whereas, the other groups appear to achieve conditioned reflex extinction by internal inhibition. Thus the hyperactive brain-damaged group approaches the extinction of the conditioned reflex through an ever increasing degree of generalized motor activity. The children in the remaining groups appear to achieve conditioned reflex extinction through the development of in-

ternal inhibition, a process which is distinguished by a diminution of general motor activity level. In the normal children and in the mongoloid children this inhibitory phenomenon is generalized into sleep which Pavlov (3) viewed as "an inhibition which has spread over a great section of the cerebrum, over the entire hemispheres and even into the lower lying midbrain."

It is apparent that the obtained differences in both establishment of conditioning and the extinction of the conditioned reflex found are independent of the scores made on tests of intelligence, and have independent implications for the management and training of hyperactive and non-hyperactive brain-injured retarded children. Thus, the children who are in the hyperactive group may function most effectively in an environment which promotes inhibition by being repetitive and limited in the number and kinds of extraneous stimuli presented. However, such a situation would not be desirable for the non-hyperactive brain-injured group and could result in generalized inhibition.

SUMMARY

The conditionability and rate of extinction of conditioned galvanic skin reflex of two groups of brain-injured children, a group of mongoloid, and a small group of normal children was studied. It was found that the group of brain-injured children who were characterized as being hyperactive and/or distractible required a significantly larger number of paired presentations of light and shock to reach the criterion for conditioning than did a group of brain-injured children who were not so characterized. It was found that the group of mongoloid children required a longer conditioning period than did the group of non-hyperactive and/or distractible brain-injured children.

While there was no significant difference in the number of extinction trials required by the groups studied, there were major differences in the extinction process. The most striking difference was that the hyperactive and/or distractible group of brain-injured children gave little evidence of a buildup of internal inhibition and maintained and sometimes increased their activity level as the extinction series wore on. On the other hand half of the children in both the mongoloid and normal groups demonstrated that internal inhibtion was building up by falling asleep at some point during the extinction series.

The results are discussed from the standpoint of conditioned reflex theory and suggest that the population of brain-injured children is not a homogeneous one. The various kinds of behavior displayed by brain-injured children may be understood as the result of disturbances in normal cerebral functioning which modify the effective equilibration of excitation and inhibition.

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THE INFLUENCE OF CHLORPROMAZINE ON PATHOLOGIC EMOTIONS AND SEXUAL UNREST

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Diagnostic considerations, methods of administration, and complications relevant to the use of chlorpromazine have been widely reported. Detailed analyses of the emotional responses to chlorpromazine have been presented by Winkelman (6), Malitz and Hoch (5), Feldman (2) and others. It is the purpose of this report to modify and enlarge upon these observations by demonstrating the influence of this drug on dynamic psychopathologic features and related emotions. Such information is essential in order to understand the nature of the symptomatic changes induced with chlorpromazine, and to provide a sound basis for its clinical use.

This study is based on the analysis of the effects of chlorpromazine in 142 unselected in-patients treated at the Payne Whitney Psychiatric Clinic during the past three years. In general, the drug was used as an adjunct to intensive psychotherapy in the setting of a dynamically planned environmental therapeutic regime. The drug was administered orally, except for the control of acute, intense reactions, where the intramuscular route was used initially. The daily dose did not exceed 1000 mgs. orally, and the oral maintenance dose averaged 200–400 mgs. per day.

The emotional and psychopathologic features of the patients under investigation were determined before, during, and at the end of treatment. For these determinations, the authors depended upon personal contact with the patients, supplemented by the examination of clinical records, in particular the special behavior graphs described by Kohl (4).

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Those psychopathologic features pertinent to this presentation and therefore requiring clarification include sexual unrest, paranoid features, depression of mood, pathologic fear, anxiety and hostility, and confusion. These features were considered to be present only when they were readily observable in the appearance, behavior or verbal productions of the patients. Unconscious factors, which were not apparent but could be inferred from a dynamic understanding of each patient's condition, were not included in the evaluation.

Sexual unrest was considered present when a patient evidenced sexual behavior of an autoerotic, homosexual or heterosexual type, through verbal expression or in activity. Such states of mild or intense excitement were noted in dreams, conscious phantasies, physical sensations or erotic behavior in group relationships as seen in bodily appearance, dress, conversation and actions. Paranoid features were considered present when a patient evidenced well-defined suspiciousness of the environment, ideas of reference, or frank delusions of a persecutory nature. Depression of mood was considered present when a patient used such terms as "sad, hopeless or discouraged" to describe his state, or when his appearance or the content of his thinking revealed a depressive mood even if he were not clearly aware of it. Fear was recognized as an intense emotional reaction of a patient to an immediately dangerous stimulus, arising from the environment or due to the overwhelming emergence of previously unconscious feelings, particularly sexual and aggressive impulses. At times, fear was so intense that a state of panic was considered present, involving the total personality, leading to ideas of reference, paranoid de-

lusions, or hallucinations, as described by Diethelm (1). Pathologic anxiety, on the other hand, appeared to be intimately related to the repression of threatening, unconscious conflicts, and was considered present when a patient subjectively or in his appearance and activity revealed apprehension. Anxiety was at times generalized, at other times focused on specific objects, as in phobic states. In certain patients associated manifestations of anxiety included agitation, interrupted sleep, elevated pulse rate and various symptoms of autonomic nervous system overactivity. Pathologic hostility was considered present when a patient verbally, through facial expression or gesture, indicated the presence of anger or resentment, overtly experienced and outwardly directed. Confusion was considered present when a patient demonstrated that extreme degree of bewilderment, perplexity and disturbed associative functions seen in certain schizophrenic and manic states.

In addition to determining the leading emotions and psychopathologic features, the evaluation of the degree of improvement occuring during the administration of chlorpromazine was carried out in each patient. The following definitions of improvement were employed. If the patient demonstrated no observable improvement, he was classified as unchanged. Mild improvement indicated a slight decrease in symptoms, allowing a somewhat better adjustment within the hospital setting, but limited to minor features without significantly influencing the central psychopathologic condition. Moderate improvement indicated distinct alleviation in the central psychopathologic features, but with residual incapacitation by symptoms. Marked improvement was considered to be present when the patient was entirely free of symptoms.

In describing results, patients will be grouped into three categories: those who showed no improvement, those who showed slight improvement, and those who showed either moderate or marked improvement.

RESULTS

General and Diagnostic Considerations. In this series of 142 patients, 124 (87.4 per cent) improved on chlorpromazine, but only 72 (50.8 per cent) to a moderate or marked degree. The sex distribution of patients was nearly equal, 64 men and 78 women, and the results of treatment were identical for each group. Patients with an acute onset (55 cases) or a duration of illness of less than one year (91 cases) responded better than those with a gradual onset (87 cases) or a duration of illness exceeding one year (51 cases). No significant variations appeared when improvement was related to the duration of treatment, the maximal and maintenance doses of chlorpromazine or the side-effects of drug administration.

Certain well-defined trends appeared when improvement was analyzed in terms of diagnostic groups. The most consistently satisfactory responses were noted among patients diagnosed as paranoid reactions (seven cases), manic excitements (ten cases), paranoid schizophrenic reactions (22 cases), and catatonic excitements (14 cases). Sixty-four and three-tenths per cent to 85.8 per cent of patients in these four groups improved to a moderate or marked degree on chlorpromazine. Nearly 50 per cent of the 23 patients diagnosed as simple schizophrenic reactions improved to a moderate or marked degree. The poorest responses, less than 25 per cent improved moderately or markedly, were observed in eight patients in catatonic stuporous reactions and five patients in hebephrenic states.

Of the 42 patients diagnosed as depressive mood reactions, 38 per cent improved moderately or markedly. It is important to point out that in this group chlorpromazine did not usually relieve the depressive mood. Nonetheless, marked changes could often be seen in associated psychopathologic features such as paranoid delusions or strong hostility leading to aversion reactions.

Eight patients with psychoneurotic reactions and three with organic reactions in-

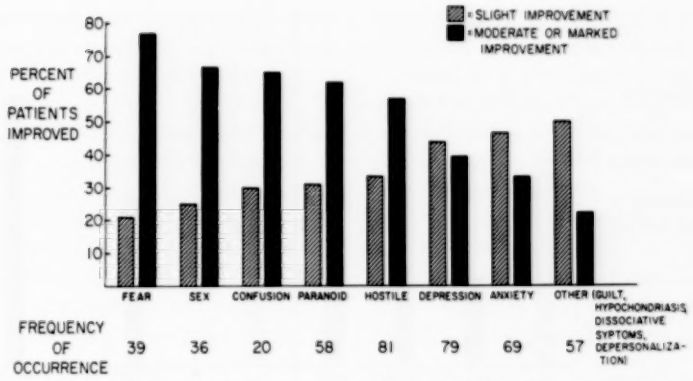

FIG. 1. Response to chlorpromazine by psychopathologic features.

cluded in this study were too few and too varied to draw any definite conclusions about the efficacy of chlorpromazine in such conditions. On the whole, the degree of improvement in these patients did not appear to be as satisfactory as in other diagnostic groups.

Emotional and Psychopathologic Considerations. Significant variations were observed when the response on chlorpromazine was analyzed in terms of the prominent emotional and psychopathological features which these patients presented. These are demonstrated in Figure 1, the solid bar indicating moderate or marked improvement and the hatched bar indicating slight improvement. Nearly all patients improved on chlorpromazine, but the degree of improvement varied strikingly from one group to another. Moderate or marked improvement was observed in 76.9 per cent of 39 patients with fear, 66.7 per cent of 36 patients with sexual unrest, 65 per cent of 20 patients with confusion, and 62 per cent of 58 patients with paranoid features. Of 81 patients with hostility, 56.9 per cent improved moderately or markedly. Thirty-nine and one-half per cent of 79 patients with depression of mood, 33.3 per cent of 69 patients with anxiety, and 22.2 per cent of 57 patients with other psychopathologic features, namely guilt, hypochondriasis, depersonalization, and dissociative symptoms, improved moderately or markedly, a much less adequate response on the drug than seen in the previous groups.

In the preceeding analysis the response to chlorpromazine was examined in relation to the presence or absence of one particular pathologic feature. A subsequent inspection of data was undertaken in order to determine whether the anticipated rate of improvement established for paranoid features, sexual unrest, pathologic hostility or anxiety would be influenced by the presence of a second prominent symptom. The results of this analysis are shown in Figure 2, the hatched bars indicating the rate of moderate or marked improvement in all patients demonstrating the particular psychopathologic feature under consideration, and the solid bars indicating the rate of moderate or marked improvement among those patients in whom one or another associated symptom was also present.

Of 58 patients with paranoid features, 62 per cent demonstrated moderate or marked improvement on chlorpromazine. The presence of depression of mood in 24 of these patients did not significantly change the improvement rate, 62.5 per cent improving moderately or markedly. In 12 cases paranoid features were combined with anxiety, and here the improvement rate decreased markedly to 25 per cent. Paranoid features were associated with fear in 23 cases, with

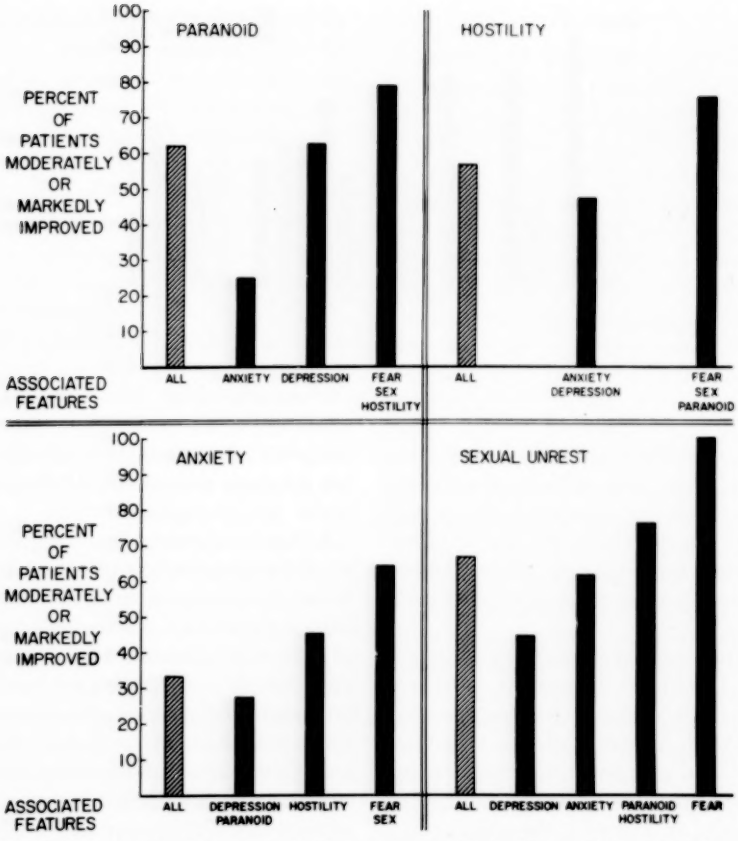

FIG. 2. Response to chlorpromazine by psychopathologic features in combination.

hostility in 28 cases, with sexual unrest in ten cases; in each of these groups the improvement rate increased to 79 per cent.

Of 81 patients with hostility, 56.9 per cent improved moderately or markedly on chlorpromazine. This improvement rate decreased to 47.4 per cent when hostility was associated with either anxiety, as in 31 cases, or depression of mood, as in 33 cases. Hostility was combined with fear in 13 cases, with paranoid features in 28 cases, with sexual unrest in 18 cases; and in each of these groups the improvement rate increased to 75.6 per cent.

Only one-third of 69 patients with anxiety improved moderately or markedly on chlorpromazine. When anxiety was associated with depression of mood as in 37 cases, or paranoid features as in 12 cases, the improvement rate decreased to 27.4 per cent. However, the improvement rate rose to 45.2 per cent in 31 cases combining anxiety with hostility; to 64.2 per cent in three cases combining anxiety with fear; and again, 64.2 per cent in 13 cases combining anxiety with sexual unrest.

Of 36 patients with sexual unrest, two-thirds improved moderately or markedly on chlorpromazine. In 13 cases, sexual unrest was combined with anxiety and the improvement rate remained essentially unchanged, namely, 61.7 per cent. Sexual un-

rest was combined with depression of mood in nine cases, and the improvement rate was reduced to 44.5 per cent. Sexual unrest was associated with paranoid features in 10 cases and hostility in 18 cases, and in each group 76 per cent improved moderately or markedly. In eight cases, combining sexual unrest with fear, the improvement rate rose to 100 per cent.

In this series of patients, therefore, significant variations in the response to chlorpromazine were associated with the presence of specific emotions and psychopathologic features, singly and in combination.

DISCUSSION

These observations indicate that the clinical improvement in psychiatric patients receiving chlorpromazine is related to the ability of this drug to reduce sexual unrest or strong emotions of fear or hostility. Paranoid delusions appear to be alleviated primarily when they are associated with these emotions.

Contrary to frequent reports, chlorpromazine appears to be relatively ineffective in patients with anxiety. If anxiety is present in association with sexual unrest or hostility, the drug may still be of value. Such a combination seems to exist in severely agitated depressed patients, where chlorpromazine is far more effective than barbiturates in reducing the marked apprehension, restlessness and over-activity complicating the depressed state. If, on the other hand, anxiety occurs in the absence of these features—as in psychoneurotic reactions based on repression of sexual drives and aggressive impulses—chlorpromazine may be useless, and at times may even intensify the symptoms of the condition.

When sexual unrest, fear or hostility constitute the central features of a patient's condition—as in a sexual panic or excitement—the improvement associated with the administration of chlorpromazine may be striking. However, it is also possible to constructively modify the clinical condition of a patient in a more limited manner. In depressive mood disorders, for example, chlorpromazine will not influence depression but will substantially reduce sexual unrest, fear, hostility and related paranoid delusions, thereby facilitating intensive psychotherapy in a hospital setting (3).

The influence of chlorpromazine on sexual unrest suggests that the drug may exert a significant effect on endocrine function, particularly adrenal or sex steroid production. Such a physiological action may prove to be as important as the effects of chlorpromazine on the central nervous system.

SUMMARY

The effective use of drugs in psychiatric treatment requires specific knowledge of the influence of pharmacologic agents on emotions and related psychodynamic factors which may markedly influence the clinical state of any patient. When attention is paid to these features, it is possible to develop a useful scheme, which not only deepens the understanding of the nature of clinical changes induced with drugs, but also allows for the selection of the correct method of treatment for an individual patient in a particular phase of an illness.

This study reports the effects of chlorpromazine in a series of 142 patients who received the drug as an adjunct to intensive psychotherapy in a hospital setting. Good therapeutic results were obtained in patients demonstrating fear, hostility, or related paranoid features. Contrary to general opinion, chlorpromazine appeared to be singularly ineffective in many conditions where anxiety was a leading feature. The marked ability of chlorpromazine to reduce sexual unrest has received very little recognition, yet this influence may contribute substantially to its broad clinical usefulness in the treatment of psychiatric disorders.

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THE METABOLISM OF MESCALINE WITH A NOTE ON CORRELATIONS BETWEEN METABOLISM AND PSYCHOLOGICAL EFFECTS[1]

L. C. MOKRASCH, PH.D.[2] AND IAN STEVENSON, M.D.[3]

INTRODUCTION

The hypothesis that a biochemical mechanism underlies the symptoms of schizophrenia has received increasing attention in recent years. Osmond and Smythies proposed that some substance related to epinephrine and mescaline might play a part in the mechanism of schizophrenia (12). Mescaline and other chemically related compounds have been shown capable of depressing the oxidation of nervous tissue (14) and also of acting as synaptic inhibitors in the brain (10). Mescaline thus qualifies as capable of producing the cerebral changes which can in turn underlie important psychological disorders. Although mescaline is not a naturally occurring substance of the human body, its chemical kinship with such substances and its known chemical and psychological effects make its further study valuable.

Epinephrine is rather rapidly oxidized in the human body but some of the related amines such as amphetamine, ephedrine and mescaline are not. The effects of these latter compounds may last for twenty-four hours or more. These differences may depend on different speeds of oxidation of the compounds (15). Alternatively, compounds such as mescaline may be converted into or activate the production of other compounds which are the active psychotogenic substances. The work of Block in animal experiments (5) has yielded some evidence of the conversion of mescaline into some other possibly active substance.

Although the administration of mescaline is accompanied by a pattern of well-studied psychological changes (7, 21) the symptoms vary widely between different subjects receiving comparable doses. The same is true of the psychological changes accompanying the administration of lysergic acid diethylamide (1). Few studies have been made on the metabolism of mescaline in human subjects (6, 8, 11, 15, 17) most of them before the development of modern analytical methods.

The foregoing data and speculations made worthwhile a study of the metabolism of mescaline in human subjects together with an attempt to correlate metabolic and psychological changes.

METHODS

The subjects were eleven young men and women between the ages of twenty and forty drawn through volunteering from the students and staff of the Louisiana State University School of Medicine. We are aware that this method of selection is far from random and can attract persons who are not average and possibly quite abnormal (9). However, the subjects were ostensibly in good physical and mental health at the time of the experiments. The subjects knew they were to receive mescaline during the experiment and at the time of invitation to participate were told briefly about the usual effects of the drug. Subsequently most of them learned more about the action of the drug either during a preliminary interview with one of us or from reading.

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The experiments were conducted in the fasting state beginning between 7 and 9 A.M. On most experimental days experiments were conducted simultaneously on two subjects. The subjects were in the same room usually lying on beds, although occasionally walking around. The subjects sometimes interacted with each other, but much more often became involved in their own subjective experiences and paid little attention to the other subject in the room. After initial samples of blood and urine had been taken, and an initial psychological evaluation made, mescaline sulfate (Hoffman-LaRoche) was administered intravenously in doses of 5 mgm. per Kgm. This meant that most of the subjects received between 350 and 400 mgm. of mescaline. The drug had been dissolved in distilled water at a concentration of 40 mgm. per ml. and subsequently sterilized before injection. Studies of the actual concentration of the drug injected showed that some variations in concentration had occurred during the preparation of the solution. These variations were considered small enough to be disregarded.

After the administration of the mescaline, psychological evaluations were continued throughout the period of the drug's effects. Detailed notes were made of the subject's verbalizations and other behavior. At frequent (usually hourly) intervals a complete mental status examination was made. For these evaluations a rating sheet was devised consisting of some forty items grouped under the headings of perception (*e.g.*, illusions, after-images, synesthesiae), mental processes (*e.g.*, ability to calculate, capacity for abstract thinking) and emotion and behavior (*e.g.*, anxiety, elation). In every experiment two or more observers studied the psychological state of the subject. The data of the rating scale were used to evaluate the total psychological changes in the subjects. For this purpose ten major parameters of change (*e.g.*, alterations of mood, alterations of perception of the environment, interference with mental processes) were used and two observers independently scored the subjects with regard to such changes. From these scores estimates were derived of the degree of psychological changes in each subject. Throughout the period of observation samples of blood and urine were drawn. Between six and eight specimens of blood and urine were obtained from each subject. The subjects were kept under close observation until they were judged to have nearly or completely recovered from the effects of mescaline when they were taken home. The duration of close observation thus extended over eight to ten hours. Over the next day or several, subsequent contacts with the subjects permitted study of residual effects which occasionally occurred.

Some of the subjects received sodium succinate whose antidotal action was studied and reported elsewhere (20). Most of the subjects received mescaline on two occasions, once with and once without the administration of succinate. Twenty experiments were conducted altogether.

ANALYTICAL PROCEDURES

BLOOD ANALYSIS

Methoxylated acids. Duplicate 5 ml. samples of whole blood, (preserved immediately on drawing by NaF to a concentration of 0.01 M and by refrigeration) were mixed with 25 ml. 0.59 M trichloroacetic acid and allowed to stand at room temperature for one hour with occasional stirring. The suspensions were then centrifuged 15 minutes at 1800 g. 25.0 ml. of the supernates were transferred to beakers containing 1.0 ml. 0.5 N metaphosphoric acid and were evaporated to about 1 ml. by the application of heat. The concentrated solutions were transferred quantitatively with distilled water washes to centrifuge tubes and diluted to 4 ml. The acid solutions were extracted twice with 5.0 ml. toluene (redistilled). The toluene phases were separated quantitatively from the aqueous phases which were saved for the procedure described in the next section.

The combined toluene extracts were treated with 1.0 ml. 0.5 M $NaHCO_3$ followed by 2 × 1 ml. of distilled water. The combined $NaHCO_3$ extracts were evaporated to dryness in a Zeissel flask and the usual Zeissel technic (24) was then applied to determine the methoxylated acids.

Since the extracted material was free of interfering substances and since no additional methoxyl compounds could be recovered from the acid blood extract, no additional extractions for the acid products were performed.

Methoxylated amines. The aqueous phases remaining from the first toluene extraction (preceding section) were made strongly alkaline by 1.2 to 1.5 ml. 10 M NaOH. These were then extracted with 2 × 5 ml. toluene, following which the aqueous phases were discarded. The combined toluene extracts were treated serially with 1.0 ml. 0.1 M HCl and 2 × 1 ml. distilled water. The combined HCl extracts were evaporated to dryness in the Zeissel flasks and the usual Zeissel technic applied.

Additional extractions recovered no more methoxyl compounds and no interfering materials were present; therefore the procedure is satisfactory in its simple form.

URINE ANALYSIS

Methoxylated acids. Duplicate 3.0 ml. samples of urine (preserved by the addition of 0.1 mg. $ml.^{-1}$ HgI_2 and by refrigeration immediately after collection) were mixed with 0.25 ml. 12 M HCl and heated 15 minutes at 100° in stoppered tubes. The cooled solutions were extracted with 3 × 5 ml. toluene and the aqueous phases were saved for the procedure described in the next section. The combined toluene extracts were treated with 1.0 ml. 0.5 M $NaHCO_3$ and 2 × 1 ml. water. The $NaHCO_3$ extracts and water washes were combined and evaporated to dryness in the Zeissel flask.

Methoxylated amines. The aqueous phases remaining from the first toluene extraction (preceding section) were made strongly alkaline with 10 M NaOH and extracted with toluene as before. The toluene phases were treated with 0.1 M HCl as described for blood analysis at the same stage. Exactly 0.10 of the HCl solutions were taken for Zeissel determinations.

Alternatively the total toluene-soluble amines in the urine was determined by a method similar to that of Woods *et al.* (23).

The results of the colorimetric determination on urine amines and of the Zeissel determination on urine amines are consistent with the assumption that mescaline or a closely related trimethoxyamine was the amine solely elevated in concentration in the urine of intoxicated subjects. The colorimetric method was not suitable for measuring blood mescaline owing to the presence of interfering substances giving high blank values.

Rigorous characterization of the mescaline metabolites was not attempted; however, blood and urine extracts separated on paper chromatograms disclosed the presence of an amine associated with three alkoxyl groups and an acid associated with three alkoxyl groups, as the main alkoxyl-bearing compounds (about 80 per cent of the total). The acid had a pKa of about 5, consistent with the notion that it is a carboxylic acid. A third methoxyl component migrated between the main two but was not characterized.

RESULTS

Blood levels and rates of excretion of mescaline and trimethoxyphenylacetic acid. The blood levels and rates of excretion of mescaline in the urine are illustrated in Figures 1 and 2. Figure 1 also includes a line indicating the severity of symptoms. The curves of blood level and rates of excretion of mescaline did not fall asymptotically, but instead showed a definite flattening and in most instances an elevation between the third and sixth hour after administration of the drug. The curves of blood level and rates of excretion of trimethoxyphenylacetic

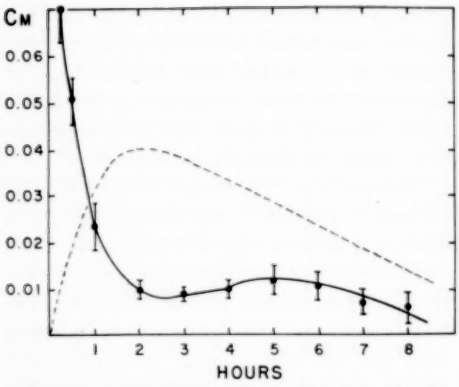

FIG. 1. Concentration of mescaline (micromoles per cc.) in blood after intravenous administration (solid curve). Means and mean deviations are indicated. Broken curve indicates usual severity of symptoms after administration of mescaline.

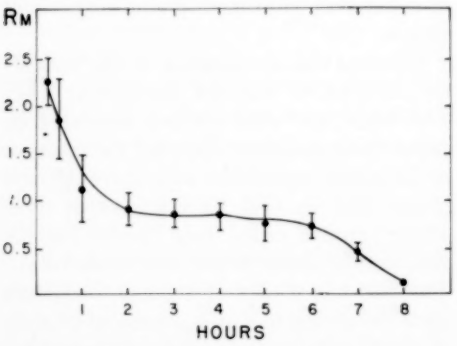

FIG. 2. Rates of urinary excretion of mescaline after intravenous administration. Rates expressed as micromoles per hour per kilogram of body weight. Means and mean deviations are indicated.

acid (Figures 3 and 4) showed this second rise to an even greater degree.

The amount of mescaline which was recovered in the urine within the first six hours ranged between 11.8 per cent and 66.7 per cent of the drug administered. The mean recovery during this period was 31 per cent. In fourteen experiments the excretion of trimethoxyphenylacetic acid was measured and it was found that an average of 7.4 per cent of the ingested drug was recovered in this form. Rather wide variations were found in the curves of blood levels and rates of excretion of mescaline of the same subject on different experimental days.

Correlations between blood levels, rates of excretion of mescaline and psychological changes. With the intravenous administration of mescaline we found that the height of psychological effects usually occurred between 1½ hours and 2 hours after the injection of the drug. Thereafter the effects wore off and had usually disappeared to the extent of about 80 per cent recovery by the end of nine hours. Most of the subjects declared

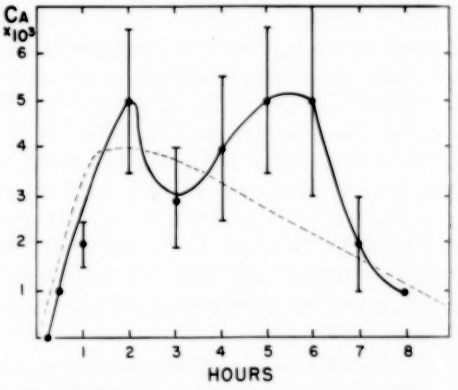

FIG. 3. Concentration of trimethoxyphenylacetic acid (micromoles per cc. times 10^3) in blood after intravenous administration of mescaline (solid curve). Means and mean deviations are indicated. Broken curve indicates usual severity of symptoms after administration of mescaline.

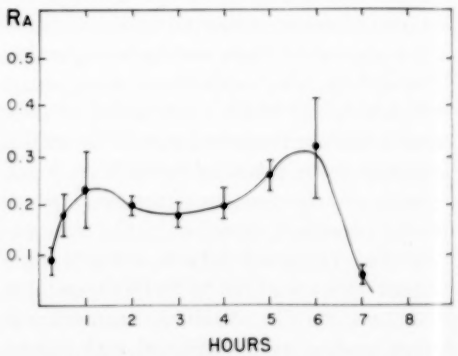

FIG. 4. Rates of urinary excretion of trimethoxyphenylacetic acid after intravenous administration of mescaline. Rates expressed as micromoles per hour per kilogram of body weight. Means and mean deviations are indicated.

themselves entirely free of symptoms by the next morning (24 hours after the injection). Two of our subjects had residual symptoms lasting several days.

In general the height of psychological effects followed the period of maximal blood levels and rates of excretion of mescaline by an hour or two (see Figures 1 and 2). On the other hand, the period of maximal psychological effects did coincide rather closely with the first peaks in the blood levels and rates of excretion of trimethoxyphenylacetic acid (Figures 3 and 4).

The psychological effects in our subjects resembled those described by previous authors (7, 12, 21). These effects were far from uniform, however, since wide variations in psychological responses to these drugs occur (1, 13, 19). Variations occurred both in degree of response and in the mental functions most affected. Thus some subjects experienced marked changes in visual perception with little change in mood. Others showed marked elevation of mood with little or no change in perception and an impoverished thought content. Others showed great enrichment of thought content with little change in perception. We were unable to correlate these variations of severity and quality with any of the following: a) blood levels of mescaline at the height of psychological effects; b) rate of excretion of mescaline at the height of psychological effects; c) amount of mescaline (per cent of drug administered) excreted within six hours; d) differences in the ratio of mescaline and trimethoxyphenylacetic acid excreted. The latter ratio presumably reflects somewhat the breakdown of mescaline. We also found no correlations between the severity of symptoms judged by our criteria and either the rapidity with which the height of psychological effects was reached or the total duration of these effects.

DISCUSSION

The observation of a delayed decline and even increase in the blood level and urinary excretion of mescaline and trimethoxyphenylacetic acid several hours after the injection of mescaline supports the hypothesis that some of the mescaline is deposited in the tissues from which portions of it not otherwise metabolized are subsequently released and excreted as mescaline or, after deamination, as trimethoxyphenylacetic acid. In experiments with mice using mescaline containing radioactive carbon, Block *et al.* found evidence that mescaline is incorporated in the tissue proteins from which it is subsequently released with excretion in the urine and feces. Moreover, he traced rather little of the mescaline to the brain compared to the liver and other organs (5). Vogt (22) and Cochin *et al.* (6) also found significantly smaller amounts of mescaline in blood and brain (of dogs) compared to the amounts found in liver and kidney.

Slotta and Mueller (17) identified and measured the excretion of trimethoxyphenylacetic acid in rabbits and dogs, but were unable to recover any of this substance in the urines of humans after the ingestion of mescaline. Cochin *et al.* (6) also found some trimethoxyphenylacetic acid in the urine of dogs given mescaline. Harley-Mason *et al.* (8), using a paper chromatographic technique, also failed to find any trimethoxyphenylacetic acid in the urines of six subjects given doses of mescaline comparable to our doses. They also reported finding small amounts (1–2 per cent of the dose) of the glutamine conjugate of 3:4-dihydroxy-5-methoxyphenylacetic acid.

Some variations have occurred in the recoveries of mescaline in the urines of experimental animals and humans. Working with dogs, Cochin *et al.* (6) recovered between 28 and 46 per cent of the administered dose within 24 hours. Richter (15) in one human subject recovered 58 per cent of the administered drug after 24 hours. These investigators measured amino groups. Harley-Mason *et al.* using a paper chromatographic method recovered from six human subjects an average of 35 per cent of the adminis-

tered drug within 24 hours. Salomon *et al.* (16) recovered an average of 30 per cent of the administered drug in six human subjects within eight hours, measuring methoxy groups by the Zeissel method. Our own recovery with the same method was somewhat larger than this and averaged in our eleven subjects 31 per cent of the administered drug within six hours.

A number of investigators have studied the breakdown of mescaline *in vitro*. Bernheim and Bernheim (3) derived evidence that a rabbit liver preparation, presumably through the activity of amine oxidase, oxidized mescaline to trimethoxyphenylacetic acid which they isolated. Preparations of rat, guinea pig, cat and dog liver had little or no capacity to oxidize mescaline. Blaschko (4) and Steensholt (18), on the basis of other experiments, doubted that amine oxidase takes part in the oxidation of mescaline. Axelrod (2) has shown that a rabbit liver preparation demethylates mescaline. Recently Zeller has studied the oxidation of mescaline by tissue preparations from a number of species. The enzyme studied by Zeller (most active in rabbit preparations) oxidized the mescaline presumably to trimethoxyphenylacetic acid and had inhibitor characteristics of a diamine oxidase. Our own observations show that in humans at least some mescaline is deaminated before demethoxylation occurs or is completed.

Our failure to find correlations between the levels of mescaline in the blood and urine and the psychological effects of this drug may derive from the difficulties in evaluating the psychological changes. The occurrence simultaneously of several different psychological changes and the diversity of these changes in different subjects makes difficult an estimation of severity of changes for the comparison of one subject with another. Moreover, the communication of their experiences by the subjects to the observers can become seriously limited by alterations in communication as a result of elation and garrulity, withdrawal into reveries, or fears of revealing psychopathological changes to the observers.

Alternatively, the different responses may derive from other factors in the study of which our biochemical techniques are still inadequate. The study of the blood and urine alone permits few inferences of what may occur in the tissues. However, the observations of Vogt, Cochin *et al.* and Block *et al.* show that some mescaline is incorporated in the tissues of animals for a time. Our observations similarly suggest a temporary storage in humans. The usual gap of about one or two hours between the time of maximal psychological effects and the time of greatest blood levels and urinary excretions of mescaline suggest that the action of the drug may depend upon its conversion to another substance or to its slowly inducing a metabolic dysfunction which outlasts the presence of the drug itself in the brain or other tissues affected. The other substances produced from mescaline may then be directly responsible for the effects on the central nervous system.

SUMMARY

Eleven volunteer subjects were given mescaline intravenously in twenty experiments. For the period of intoxication blood levels and rates of urinary excretion of mescaline and trimethoxyphenylacetic acid were measured and observations made of the subjects' behavioral responses.

The behavioral responses of the subjects varied widely in severity of symptoms and in the pattern of disturbance of mental function.

An average of 31 per cent of the drug administered was recovered in the urine within the first six hours after the administration of the drug. An additional 7.4 per cent (average) of the administered drug was recovered as trimethoxyphenylacetic acid.

The blood levels and rates of excretion of mescaline did not fall off asymptotically, but formed a flattening curve and often one

with some elevation between the third and sixth hour after administration of the drug. The blood levels and rates of excretion of trimethoxyphenylacetic acid showed such secondary peaks to an even greater extent.

The period of maximal behavioral changes followed the period of maximal blood level and excretion by one to two hours.

No correlations were observed between degree or type of behavioral responses and blood levels or rates of excretion of mescaline.

The curves of blood levels and rates of excretion of mescaline and trimethoxyphenylacetic acid and the delay in occurrence of maximal behavioral change suggest that mescaline may be converted into some other substance which is directly responsible for the effects on the central nervous system.

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AN EVALUATION OF THE THERAPEUTIC USE OF TRIFLUPROMAZINE IN MENTAL DISEASE

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Trifluprομazine is a phenothiazine derivative which promises to be of value in the treatment of mental and emotional disorders. To measure quantitatively its activity as a phrenotropic agent, a comprehensive trial procedure was designed to be carried out in conjunction with an overall appraisal of clinical response to treatment. Chlorpromazine, the most familiar of the phenothiazines and a drug widely used in the treatment of psychotic states, was employed as a frame of reference in this study. Drug therapy was administered to a series of hospitalized schizophrenic patients none of whom had been given tranquilizing medication for at least three months before the project was undertaken. Patient selection is always a problem in evaluating phrenotropic compounds. Efforts were made to exclude from the study cases of organic brain pathology since it was felt that inclusion of such patients would affect the validity of the results. Consideration was also given to the age of the patients but it was not always possible to set and adhere to limitations in this area. Full details of the experimental approach and clinical findings are presented in this communication.

METHODS

A double blind study was carried out employing trifluprομazine, chlorpromazine and placebo tablets identical in outward appearance. Three equal groups of 50 patients were arbitrarily assigned one to the three types of tablets. The use of a placebo was intended to nullify the "placebo effect" often observed in drug evaluation. Chlorpromazine was included so that the appearance of symptoms associated with phenothiazines, such as parkinsonism, would not automatically identify the test drug as trifluprομazine. Neither the patients nor the attending staff was aware of the drug assigned to a particular group. Only the pharmacist, who dispensed the tablets in individual containers marked with the name of the patient, could identify the drug assigned to the various patients during this study. The nursing staff cooperated in making certain that medication was taken regularly as prescribed. The persons employed in evaluating patient progress were informed only that three types of tablets were dispensed and were unable to identify the medication assigned the various groups.

SELECTION OF PATIENTS

Patients for this study were chosen because they exhibited a combination of symptoms indicative of a schizophrenic reaction. These included:

1. Emotional blunting, showing itself in apathy or indifference.
2. Loss of pride in personal appearance.
3. Ideas of reference.
4. Lack of insight.
5. Defective judgement.
6. Overactivity in motor sphere; tics, mannerisms, bizarre postures.
7. Regression to a childish mode of thought.
8. Introversion.
9. False perception (hallucinations).
10. Delusional ideation.
11. Ambivalence.
12. Grotesque fears.
13. Autistic thinking.

[1] Eastern State Hospital, Williamsburg, Virginia. Trifluprομazine, 10-(3-dimethylaminopropyl)-2-(trifluoromethyl) phenothiazine hydrochloride, was supplied as Vesprin by E. R. Squibb & Sons, New York, New York. This study was supported by a grant from E. R. Squibb & Sons who also furnished all of the necessary drugs.

TABLE 1

Distribution of Patients by Diagnosis

Diagnosis	N
Manic Depressive	4
Hebephrenic	32
Paranoid	38
Catatonic	32
Simple	6
Involutional psychotic reaction	1
Psychoneurotic depressive reaction	1
Schizophrenic—Schizoaffective	1
Unspecified	9
	124

Patients selected for this study were separated from the patient population and placed in two wards where a constant environment could be maintained, thereby eliminating any differences in progress which might be attributed to environmental factors. A sample group of individuals was subjected to clinical laboratory tests including hemoglobin determinations, white blood cell and differential counts, icteric index, urinalysis, blood urea nitrogen, blood urea, and serum bilirubin before medication was instituted, three months thereafter, and at the completion of the evaluation. The period of appraisal extended for six months. Although most patients were hospitalized during this time, where recovery was sufficient to justify discharge, the patient was released and followed up. All patients were given the battery of psychological tests described below.

STATISTICAL ANALYSIS OF THE PATIENT GROUP

The total number of patients fully evaluated in this study was 124, seventy-five men and forty-nine women. All could properly be described as suffering from a mental illness of severe proportions and this designation is confirmed by the figures for the average ages of the group and the average duration of illness. For men, the average age was 44.44 years and the average duration of illness 18.53 years.[2] For women, the average age was 49.24 years and the average duration of illness 18.61 years.[2] The men averaged 1.45 and the women 1.65 hospitalizations. Consideration of family histories disclosed that 49 relatives of the male patients had been mentally ill, an average of 0.65 for each of the subjects. A similar review of the families of the women showed that 16 of the relatives had manifested mental disturbances, an average of 0.33 for each patient in the group.

Table 1 presents the distribution of patients by diagnosis.

[2] These figures indicate duration of illness from the onset of first observed mental symptoms. They do not refer to duration of hospitalization.

DOSAGE

Trifluprom azine was initially given to all patients in oral doses of 200 mg. daily. It was subsequently found that 100 mg. daily or 150 mg. daily, at most, was ample medication for the desired therapeutic response. Some patients could be maintained on as little as 50 mg. daily once satisfactory improvement had been achieved.

RESULTS OF THE CLINICAL EVALUATION

Appraisal of the response to treatment by medical and nursing personnel is reviewed in Table 2. An analysis of psychological test data is presented separately. The figures presented demonstrate trifluprom azine to be an effective phrenotropic

TABLE 2

Comparative Response to Treatment with Trifluprom azine, Chlorprom azine and Placebo

Medication	Grade of Response			
	A	B	C	D
Trifluprom azine	7	13	14	1
Chlorprom azine	5	8	31	0
Placebo	2	2	40	0

Key: A—No evidence of active psychosis on examination.
B—Significant improvement but continued to show symptoms of psychosis.
C—Condition unchanged
D—Condition deteriorated.

agent, worthy of serious consideration in the drug therapy of mental disease, particularly schizophrenia. This confirms previously reported experience with this agent (1, 3, 4, 10). The numbers of manic depressive, involutional and psychoneurotic reactions were too small to justify definite conclusions as to the efficacy of the drug in treating these types of afflictions.

Analysis of the laboratory tests carried out on a sample group of 13 women and 17 men disclosed no significant difference between subjects receiving trifluprazine, chlorpromazine, or placebo. The lack of deviations from normal ranges in the tests conducted indicates that the drugs, in the doses used over a period of six months, are without serious toxic effects. The question of long-term toxicity requires wider experience with these medications.

SIDE EFFECTS

It is our impression that, on a weight for weight basis, trifluprazine should be considered three to four times as potent as chlorpromazine. At the outset of this investigation, a uniform dosage of 200 mg. daily was administered to all patients. By the second day, it was necessary to reduce this amount to 100 mg. daily in 3 cases, all women, because of complaints of pain and stiffness on one side of the neck. How much of this effect was psychological is of interest since, although two of the patients were taking trifluprazine, one was taking the placebo. Dosage was adjusted according to individual response during the study and, in most cases, a maintenance dose of 100 to 150 mg. proved entirely adequate. The maximum dosage given to any patient was 350 mg. daily, in divided doses. This amount very rapidly produced parkinsonian symptoms which progressed within a few days to a stuporous state with accompanying somnolence, pronounced salivation and drooling from the mouth, hypertonus and marked difficulty in performing voluntary movements. This condition was reversible with reduction in dosage requiring, in some instances, three weeks for complete resolution.

Aside from parkinsonism, which could be controlled by administration of Artane® or Cogentin®, other side effects observed during this investigation are presented in Table 3.

Of the side effects noted, the only one considered serious was an occurrence of oculogyric crisis in a forty-one year old patient who had been showing good progress on a dosage of 100 mg. of trifluprazine daily. At her own request, because she felt that medication made her feel somewhat lethargic, dosage was reduced to 50 mg. daily. Her condition grew worse. As a consequence, she was given 200 mg. daily and on the second day of this regimen, about two hours after ingestion of 100 mg. of trifluprazine, the attack occurred. This was only an isolated incident, however, and no repetition of this symptom was experienced although medication was continued at a level of 100 mg. daily. This rare complication has been observed with other phenothiazine derivatives.

TABLE 3

Side Effects to Treatment with Trifluprazine, Chlorpromazine and Placebo

Side Effect	Trifluprazine	Chlorpromazine	Placebo
Dizziness	3	2	0
Somnolence	5	12	2
Lethargy	2	4	0
Diminished Visual Acuity	1	1	0
Rash	0	1	0
Neck Stiffness	2	0	1
Oculogyric Crisis	1	0	0

PSYCHOLOGICAL TEST BATTERY

All of the psychological tests provided quantitative measures. Part of the series was intended to evaluate mental status and part to measure perceptual-motor functioning which might be affected by the drugs.

Pre-treatment testing and screening covered an interval of approximately six weeks. The order of test administration varied from subject to subject. After the treatment period, the post-treatment tests were compiled and completed in approximately three weeks.

MULTIDIMENSIONAL SCALE FOR PSYCHIATRIC RATINGS (LORR SCALE)

The Lorr Scale (5) provides a quantitative index of pathology based on interview, psychiatric history and rating of ward behavior. The Morbidity Scores reported in the present study were based on 42 interview ratings only, as lack of experience and change of ward personnel resulted in questionable validity of the ward observations. Two clinical psychologists and a psychiatrist made the pre- and post-treatment interview ratings without knowledge of the treatment group to which the patient was assigned. In those cases where a portion of the 42 items was unratable, a prorated Morbidity Score was computed. The Unratable Score was based on the number of the Lorr Scale items for which the subject received an "unratable" from the interviewer. As this dimension was not directly accounted for in the Morbidity Score and since this aspect of the pre-treatment interviews impressed the raters as a significant indicator of contact and/or rapport, it was included as a separate measure in the test series.

PORTEUS MAZE TEST

This is a standard psychometric instrument reported to reveal changes effected by chlorpromazine treatment (6, 7). A series of paper and pencil mazes, graded in difficulty, were presented by individual testing to the subject. The scores were computed according to the manual directions (8). The I.Q. Score represents a quantitative index of the level of maze difficulty accomplished. The Morbidity Score is based on pencil lifts, wavy lines, and other qualitative signs of carelessness or confusion.

APPARENT MOTION DISCRIMINATION TEST

This task required the subject to discriminate two patterns of apparent motion provided by alternating lights. A pair of top lights, flashing simultaneously, could be programmed to alternate with paired bottom lights producing a vertical apparent motion. Another program alternated a left pair of lights with a right pair producing a horizontal apparent motion. The electronic apparatus (9) controlling the lights was designed to continuously vary the flash time from 0.005 seconds to 5 seconds. The interval between flashes could also be varied independently from 0.005 seconds to 5 seconds.

Part A of the task used in the present study varied the flash time from 0.005 seconds to 0.5 seconds with the separating interval between flashes fixed at 0.05 seconds. The subject was seated in a semi-darkened room, 12 feet from the bank of lights. Starting each trial with the flash time at 0.005 seconds produced an effect of four slightly flickering lights so that no alternation or apparent motion was detectable. As the flash time was increased at a constant gradual rate, the subject was asked to report as soon as he could discriminate the direction of the apparent motion, *i.e.* "up and down" or "sideways". After two preliminary practice trials, five horizontal and five vertical apparent motion discrimination trials were presented in random sequence. For each trial the flash time at which correct discrimination was made was recorded from dial readings scaled to 0.005 seconds. The subject's Threshold Score was the average reading of the ten discrimination trials. The subject's variability was indicated by computing the variance (σ^2) for the ten trials.

Part B of the task was essentially the same as Part A except that flash time was fixed at 0.05 seconds and the interval separating flash alternations was varied from 0.005 seconds to 0.5 seconds. The average separating interval at which correct discriminations was made provided the Thresh-

old Score for Part B. The variance for Part B trials was also computed.

Apparent motion discrimination was included in the test series after consideration of previous reports of loss of ability to perceive apparent motion due to brain damage or psychiatric pathology (11, 12). It was felt that psychiatric improvement or drug side effects might effect changes in task performance.

DOT JUDGMENT TEST

For this task, the subject was required to discriminate and sort five gradations of density of dots presented on 2¼ by 3½ white index cards. The gradations were referred to by the numbers "1" through "5" in succession from least to most dense. To provide an initial standard of judgment, the experimenter showed the subject a set of the five gradations. The standard was then removed, the cards were presented successively by the experimenter to the subject and the subject was required to judge each card for its position in the series of gradations. The subject was informed of each error. Each gradation was presented ten times, in random sequence, during the task. The total errors constituted the Judgment Score for the task. An error was defined as the difference between the position of the stimulus in the gradation series and the subject's judgment of its position. The number of seconds to complete the task was recorded for the Time Score. Since this task has previously been found to discriminate between schizophrenic patients and nonpsychotics (2) it was considered likely that it might prove sensitive to possible changes in mental status.

STAR TRACING TEST

This task, included to determine whether drug side effects might affect relatively fine hand-eye coordination, required the subject to pencil trace a star pattern with a maximum diameter of six inches. The star was outlined by a double border spaced ⅛″ apart and printed over a fine 1/16″ grid background. The subject was instructed to start at the center bottom point of the star and trace around the star in clockwise direction as rapidly as possible without going outside the double border or lifting the pencil. An Error Score was computed by counting the number of grids crossed outside the double border plus the number of pencil lifts. The number of seconds required to complete the task was recorded for the Time Score.

RAIL-WALKING TEST

This task required the subject to walk a two inch rail, four inches high and thirty inches long. The subject was instructed to walk as rapidly as possible and, if his foot touched the floor, to step back on and keep walking. The Error Score consisted of the number of times the subject stepped off the rail with one or both feet. The number of seconds necessary to complete the task was recorded as the Time Score. The task was included in the test series to reveal loss of balance and gross motor coordination as a consequence of drug side effects and parkinsonism in particular.

BODY SWAY TEST

This task required the subject to stand with legs open for one minute while attempting to avoid any sway or body movement. The subject wore a cap with a string attached to the top of which was threaded an eye suspended directly above his head. The string connected from the eye to a pointer so that any gross change in body stance deflected the pointer. An equal unit scale was affixed to the pointer to measure the extent of sway. Readings were taken every five seconds and the subject's Body Sway Score was the average of the 12 readings. The task was included in the test series to disclose drug effects on body stance and balance.

TASK PARTICIPATION

This measure was based on the number of tasks the subject completed. Reactions to the pre-treatment tests suggested that such a measure might be a significant indication of cooperation and/or contact. The subject received one point for each task completed.

RESULTS OF PSYCHOLOGICAL TESTING

Men and women were sufficiently similar in performance to warrant pooling sexes to simplify the presentation of psychological test results. The differences between treatment groups were evaluated by t except in cases where measures were in terms of frequencies or when distributions deviated from normal to an extent requiring a non-parametric statistic. In such instances chi-square or the Mann-Whitney U test was employed.

Analysis of differences between treatment groups for the 16 measures yielded only three out of a possible 48 comparisons which attained statistical significance beyond the 0.05 level. The placebo group was more variable on Part A of the Apparent Motion Discrimination Test than the chlorpromazine group. The chlorpromazine group made less errors on the Star Tracing Test than did the trifluprom azine or placebo groups. From these results it appears that the random assignment of patients to treatment groups fairly well satisfied the need for evenly matched performance in the groups before treatment was undertaken. Comparisons of treatment groups by chi-square analysis yielded only one significant difference. Forty per cent of the trifluprom azine group received fewer unratable items on the Lorr Scale for the post-treatment interviews as compared with 18 per cent for the placebo group ($p < 0.05$).

With the majority of test measures all three treatment groups showed greater percentage of improvement than the 50 per cent chance fluctuation level. The measures opposing the improvement trend were the Lorr Unratable Score, the Rail-Walking Error and Time Scores, the Body Sway Score, and the Task Participation Score. For all but the Rail-Walking Test, these discrepancies from the general trend may be accounted for in part by scores approaching the ceiling on the pre-treatment tests so that only a small margin of improvement was possible for the majority of patients.

A more sensitive analysis of changes between pre- and post-treatment tests is presented in Table 4. Differences between pre- and post-treatment measures were computed for each subject so that higher scores indicated greater improvement and negative scores reflected poorer accuracy, cooperation, consistency, or speed of performance on the retest.

A general improvement was evidenced by each of the three treatment groups. Positive mean differences scores were obtained on 14 out of 16 measures by each group. A two-tailed test based on the binomial expansion indicates this is a deviation from chance fluctuation significant for each group beyond the 0.01 level. It must be recognized, however, that the measures were not entirely independent in that some were derived from the same test, *e.g.* time and error scores.

Comparisons between treatment groups revealed nine differences significant at the 0.05 level or better. Trifluprom azine and chlorpromazine groups showed a significant degree of improvement over the placebo group on the Lorr Scale Morbidity and Unratable Scores. The placebo group, compared to the chlorpromazine group, showed greater reduction in Part B threshold and Part A variability scores on Apparent Motion Discrimination. The trifluprom azine group was significantly improved over the chlorpromazine group and over the placebo group in reduction of Star-Tracing errors. The trifluprom azine group also showed a significant improvement over the placebo group in Task Participation.

TABLE 4

Analysis of Difference Scores between Pre- and Post-Treatment Tests

Test	Vesprin			Chloropromazine			Placebo			Significance level of diff. between groups		
	Total X	N SD	40 N	Total X	N SD	41 N	Total X	N SD	44 N	Vesp. Plac.	Vesp. Chlor.	Chlor. Plac.
Lorr Scale Ratings												
Morbidity Score	9.3	15.75	40	8.0	14.23	41	1.5	10.83	44	0.02*	—	0.05*
Unratable Score	3.0	9.22	40	1.0	6.54	41	−1.3	3.97	44	0.01*	—	0.05*
Porteus Maze Test												
T.Q.	4.6	15.75	29	7.9	17.45	27	7.6	17.53	37	—	—	—
Morbidity Score	20.5	34.04	29	18.4	28.9	27	13.9	37.07	37	—	—	—
Apparent Motion Discrimination Test												
Part A Threshold	0.051	0.044	22	0.003	0.048	30	0.021	0.070	27	—	—	—
Part B Threshold	0.011	0.041	22	0.001	0.039	30	0.039	0.085	27	—	—	0.05*
Part $A\sigma^2$	0.833	1.038	22	0.491	0.825	30	1.191	1.376	27	—	—	0.05*
Part $B\sigma^2$	0.589	1.515	22	0.320	0.857	30	0.777	1.549	27	—	—	—
Dot Judgment Test												
Error Score	7.9	16.15	30	8.5	11.07	29	8.4	13.5	35	—	—	—
Time Score	10.2	147.51	30	74.2	178.07	29	25.12	160.95	35	—	—	—
Star Tracing Test												
Error Score	26.8	43.93	31	13.7	43.75	29	2.8	52.94	36	0.01†	0.01†	—
Time Score	25.6	48.62	31	13.3	49.19	29	11.7	39.62	36	—	—	—
Rail Walking Test												
Error Score	−1.8	3.70	33	−1.0	4.91	32	−0.6	3.03	39	—	—	—
Time Score	2.4	18.43	33	7.6	29.10	32	0.1	19.25	39	—	—	—
Body Sway Test	−11.9	125.70	35	−9.4	125.93	40	13.5	85.36	39	—	—	—
Task Participation	0.9	1.54	40	0.7	1.33	41	0.3	1.08	44	0.05*	—	—

Note: Only Ss completing both pre- and post-treatment tests were included in the analysis. All difference scores computed so that higher scores indicate greater accuracy, consistency or speed of performance. All time scores are reported in units of seconds.

* Probability determined by *t*.

† Probability determined by Mann-Whitney U.

DISCUSSION OF PSYCHOLOGICAL TEST RESULTS

Three trends are notable in the psychological test results. 1) All groups showed improvement on a significant majority of the post-treatment tests. 2) Triflupromazine and chlorpromazine groups showed significantly greater improvement than the placebo group on the Lorr Scale measures. 3) No impairment due to drug side effects was observed with the triflupromazine group and the placebo group was superior to the chlorpromazine group on only two Apparent Motion measures possibly related to drug side effects.

The general improvement trend may be partially accounted for by test practice or experience although the five-month interval between pre- and post-treatment tests would seem sufficient to minimize this factor. Another factor possibly producing improvement in motivation and cooperation was the increased nursing care and attention provided during the experimental program. Since there was a general improvement tendency for all groups, the placebo control group was necessary to isolate the effectiveness of the drugs. An experimental design requiring an additional control group tested at the same time intervals but given no special treatment or attention would also be helpful in future research.

Emphasis may be placed on the Lorr Scale ratings in the present study in that they provided the most comprehensive

evaluation of intellectual and emotional functioning in the test battery. Analysis of individual items in the Lorr Scale, *i.e.* orientation, emotional lability, and other such dimensions usually evaluated in psychiatric interviews, indicated that the difference in the summed or total ratings was attributable to generalized psychiatric improvement. It was interesting to note, however, that two items rating obsessive and compulsive behavior reversed the general trend and showed the drug-treated groups as poorer in improvement than the placebo group. A relationship between the development of obsessive-compulsive defenses and psychiatric improvement in chronic hospitalized patients is suggested by these data as a hypothesis for future research.

Further improvement comparisons between groups show that, of the nine significant differences recorded in Table 4, triflupromazine was superior in five comparisons and showed relatively less improvement on none while the chlorpromazine and placebo groups were each superior on two of the other four comparisons. These results tend to give triflupromazine treatment some advantages over chlorpromazine and placebo treatment.

Although impairment was anticipated for the drug treated groups on the Porteus Maze Test (designed to measure intellectual abilities of planning and spatial manipulation), such impairment was not observed in the present study. Other tests designed to measure impairment in body stance and coordination associated with drug side effects also revealed no differences between drug and placebo groups. The poorer performance of the chlorpromazine group compared with the placebo group on two Apparent Motion measures may be attributable to drug side effects but definite conclusions must await further verification of these results. Continued investigation of drug side effects might profit by the development of more sensitive ratings or measures of specific parkinsonian symptoms and of possibly related obsessive-compulsive tendencies.

CONCLUSIONS

Examination of the results of this investigation leaves no doubt that triflupromazine is an effective and useful phrenotropic agent. This seems a particularly valid conclusion when the nature of the patient group is considered. All patients treated were classified as chronically ill and were considered to have relatively poor prognosis. Side by side comparison with chlorpromazine in this series of 124 patients showed triflupromazine at least to equal the effectiveness of the older drug. It is likely that if chlorpromazine had been administered by other than a blind technique larger doses would have been prescribed. With regard to potency, our impression is that for equal therapeutic effect, the dosage of triflupromazine should be approximately one-quarter or one-fifth that of chlorpromazine. Few patients required a dosage in excess of 100 mg. of triflupromazine daily and some were adequately maintained on 50 mg. daily. Toxic central nervous system reactions, in our experience, seldom occurred unless the daily dosage exceeded 200 mg.

The battery of psychological tests employed in this investigation confirmed the clinical finding that triflupromazine produced significant improvement in this series of hospitalized patients. The techniques adopted were such as to preclude the possibility that the changes observed were the result of chance. The inclusion of a placebo group provided an objective estimate of changes due both to the increased attention received by patients involved in this study and to the psychological effects of the ritual of taking medicine.

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BRIEF COMMUNICATION

COMPARATIVE EFFECTS OF PHENAGLYCODOL AND MEPROBAMATE ON ANXIETY REACTIONS

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AND CHARLES R. KESSLER, PH.D.

A study was devised to test under controlled conditions the comparative efficacy of phenaglycodol, meprobamate and a placebo to reduce the severity of certain anxiety-based symptoms in a group of domiciled, middle-aged, male veterans diagnosed as having anxiety reactions.

A great deal has been written on the tranquilizing properties of meprobamate since its description in 1954 by Berger (2) but relatively little has yet appeared in the literature on the similar use of phenaglycodol.

Phenaglycodol is a new central relaxant drug belonging to the group of butanediols which have shown a neurosedative effect when administered to animals and humans. Structurally new among ataractics, its pharmacology and mode of action has been described by Slater *et al.* (4).

SUBJECTS

Thirty patients selected for the study were drawn from the population of male veteran residents of a VA Domiciliary. This patient group contains a wide range of medical conditions, usually of a long-standing nature, many of them complicated by the presence of anxiety or tension states, arising as a reaction to the stresses of disabling illness, socioeconomic pressures, encroaching old age, etc. The aim was to obtain a homogenous group in which anxiety and its effects were maximized. All those selected carried either primary or secondary diagnoses of chronic anxiety reaction. Those with history of psychosis, epilepsy or brain damage were excluded. All were ambulatory, of approximately average intelligence, well motivated to follow the necessary regimen, and readily able to express and describe subjective feelings. The average educational level was eighth grade, with an occupational background of the semiskilled and unskilled class. The median age of the group was 56.2 years.

RATINGS

Six symptom areas were designated for systematic observation and these were incorporated into a rating scale. Criteria for choice of these categories were: a) frequency of complaint; b) familiarity of concept to patient; c) ease and reliability of rating. The six categories were disturbances in sleep, appetite, energy, anxiety, mood and intellectual functioning. Patients placed in the study were interviewed and given an initial rating on each variable using a four-point scale as follows: 1 (poor), 2 (fair), 3 (good), 4 (excellent).

From this base line, subsequent changes in clinical status were rated (by the initial rater) on a scale extending in half-step intervals from −2 (much worse) through 0 (no change) to +2 (much improved). In addition to separate ratings in each category, a general overall rating was made, taking into account all the symptoms and complaints presented by the patient.

EXPERIMENTAL DESIGN

Design for the study followed the double-blind pattern. The medicine was prepared

[1] The Veterans Administration Center, Los Angeles, California, and the University of California at Los Angeles, School of Medicine. Drugs and financial assistance for this study were provided through the courtesy of Eli Lilly and Co. Phenaglycodol was supplied in the form of Ultran.

in identical gelatin capsules containing either 400 mgs. meprobamate, 300 mgs. phenaglycodol or a placebo. The dosage selected was that of the recommended average therapeutic dose, one capsule four times a day. Patients were under the belief they were receiving an uninterrupted six weeks' trial of a single "new tranquilizing medicine." At the end of each two-week period, patients were changed to a different preparation until every subject had received all three preparations. Each patient thus served as his own control. The order of presentation was systematically altered according to the six permutations of three variables which were designated sequences 1 to 6. Patients were then assigned to a sequence based upon a random drawing of numbers from 1 to 30. During the six-week period of the study, the patients were allowed no other "tranquilizing" or sedative medication.

Subjects were interviewed and rated weekly in the offices at the Domiciliary Mental Hygiene Clinic. Since it was desired to parallel to some extent the clinical conditions under which a private physician or ward doctor might treat large numbers of patients, efforts were made to keep interaction with the patient on a relatively impersonal level. Judgments as to change of status were based upon patients' subjective report and clinical impressions gained during interview.

RESULTS

In terms of percentage, on meprobamate 28 patients, or 93 per cent, were either improved or much improved, compared to 73 per cent on phenaglycodol and 40 per cent on the placebo. To test the significance of the difference between ratings of change, a nonparametric statistic, the Wilcoxon matched-pairs signed-ranks test (3) was used.

The differences in overall improvement on the three preparations were found to be statistically significant. Both meprobamate and phenaglycodol differed from the placebo in the direction of greater effectiveness at the .01 level; meprobamate differed from the phenaglycodol at the .02 level.

TABLE 1

Algebraic Sum of Ratings ($N = 30$)

	Meprobamate	Phenaglycodol	Placebo
Overall	39.0	22.5	4.5
Sleep	39.5	21.5	2.5
Appetite	20.5	12.0	4.5
Energy	15.0	15.0	12.0
Anxiety	35.0	18.5	5.5
Mood	22.0	11.5	−1.0
Intellect	5.5	3.5	3.0

The relative effectiveness of the preparations can be seen by comparing the algebraic sum of the change in ratings received by every patient under each condition, as shown in Table 1. These sums for meprobamate, phenaglycodol and placebo, are 39.0, 22.5 and 4.5, respectively. Also shown are the results with respect to individual symptom areas. In sleep, appetite, anxiety and mood, there was a highly significant degree of improvement of patients on meprobamate as compared to treatment with the placebo. Improvement in energy and intellectual functioning was not significantly greater.

Comparison of phenaglycodol with the control condition indicates that it also was effective in reducing disturbances in the areas of sleep, anxiety and mood. Although appetite was improved, the increase was not significantly different from that while on the placebo and, like meprobamate, it was relatively ineffective in increasing energy and intellectual functioning. Meprobamate, in turn, was significantly more effective than phenaglycodol in its capacity to improve sleep and appetite and to reduce anxiety. There was no difference between them with respect to mood, both being equally effective.

There was no correlation between age of subject and tendency to improve on either medication.

Although no laboratory studies were done on the subjects of this investigation, no toxic reactions or significant side effects attributable to the medication were noted.

DISCUSSION

One of the considerations in any clinical study is the effect of suggestion upon patient response. In the present study, 40 per cent of the group were improved to some degree while on the placebo. This corresponds with the figures for placebo effect generally reported (1). Although the effects of order of presentation were controlled in the experimental design, an analysis of the data revealed no order difference actually occurred except in the case of the placebo. Practically all of the improvement due to the placebo took place when it occupied the first position. When preceded by either experimental drug, its effect dropped to insignificance. This would seem to lend weight to the validity of the clinical improvement produced by meprobamate and phenaglycodol.

It should be pointed out that the results found were based upon the uniform administration of the recommended therapeutic dose of medication. This was in accordance with the purpose of the study to compare the relative effects of three preparations under identical conditions. It is obvious that in clinical practice one would adjust the amount and frequency of administration to secure optimum results in the individual case.

SUMMARY

The comparative effects of phenaglycodol, meprobamate and placebo administration on a group of thirty domiciled, middle-aged, male veterans with anxiety reaction was observed in a double-blind study. Patients were maintained on recommended average therapeutic doses for two weeks on successive preparations with the order of presentation being systemically varied. Changes in clinical status were rated in weekly interviews on a scale from −2 (much worse) to +2 (much improved).

On meprobamate, 93 per cent of patients were improved or much improved in terms of overall response. On phenaglycodol, 73 per cent of patients were similarly improved, and on placebo 40 per cent.

With respect to specific symptoms, meprobamate administration evoked marked improvement in sleep and anxiety level, with moderate improvement occurring in appetite and mood elevation. No significant effect was noted on energy level and intellectual functioning.

On phenaglycodol there was a substantial improvement in sleep and anxiety level with moderate improvement in mood elevation. There was no significant effect on appetite, energy level or intellectual functioning.

Comparison of the relative effectiveness of the two drugs indicated that meprobamate was significantly more effective that phenaglycodol in improving sleep and appetite and in reducing anxiety level. They were equally effective in mood elevation. Neither differed significantly from the placebo in effect on energy level or intellectual functioning.

No undesirable side effects were noted with any of the preparations.

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BRIEF COMMUNICATION

ASSOCIATION OF PSYCHOSIS WITH SEVERE RENAL GLYCOSURIA

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While renal glycosuria is of not infrequent occurrence (1), its presence in patients suffering mental disorders appears not to have been intensively studied. The present communication draws attention to this association as it has been observed in a 36 year old man hospitalized because of an affective psychosis of the manic type.

Although this was the first hospital admission for this highly intelligent patient, a history of marked instability of affect and poor judgment was present for many years. In hospital he was hyperactive, agitated, distractible, abusive and quite paranoid. Although superficially gay and constantly joking, there appeared to be a depressive core to his affect. His judgment was poor, and he became grandiose, demanding and noisy when unable to have his way in the most minor pursuits.

Routine urinalysis detected a two-plus glycosuria. Fasting blood sugar varied between 54 and 90 mg. per cent on different days. The sugar was identified as glucose. Twenty-four-hour urine samples contained 13.3, 16.3, and 87.5 grams of sugar. Oral glucose tolerance revealed a flat curve with a maximal value of 105 mg. per cent.

Two postprandial blood sugars were found to be 110 mg. per cent one hour after a meal and 105 mg. per cent two hours after a meal respectively, and postprandial urinary sugars were 1+ to 3+. Electrolytes, including calcium, phosphorus, potassium, chloride, and sodium were all within normal limits. Total serum bilirubin, urinary amino acid nitrogen, and ammonia nitrogen, PSP excretion, protein bound iodine, and serum cholesterol were all normal.

An intravenous glucose tolerance test with 35 grams of glucose showed an immediate post-infusion value of 189 mg. per cent and an abrupt drop to 118 mg. per cent in 20 minutes with a diuresis of 600 cc. in 30 minutes containing 15.5 grams of glucose. Total urinary losses of glucose were 16.2 grams in four hours. Repetition of the glucose tolerance test 18 months later revealed an even more marked loss of glucose, 27.8 grams being excreted in the urine in 30 minutes with blood glucose values at 92 mg. per cent 30 minutes post infusion. This apparent progression of his renal lesion was accompanied by a deterioration in his clinical condition. Intravenous fructose and galactose tolerance tests revealed essentially normal curves. There was no history of other renal disease. One parent, two nephews and a niece have been found to have renal glycosuria. Hepatic glycogen storage and release were normal in terms of the response to epinephrine. Thus, 0.5 cc. of a 1:1000 solution of epinephrine, subcutaneously, produced the following blood sugar values at 0, 30, and 90 minutes respectively: 58, 106, and 68 mg. per cent. The response to insulin was also normal.

Electroencephalography revealed a general instability with discrete bilateral bursts of fast wave activity (20–30/sec.). These bursts were more exaggerated on fasting (8.0 secs. fast activity/min.), did not change on the control intravenous injection of saline (7.24 secs. fast activity/min.), but diminished appreciably on the intravenous in-

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jection of 50 per cent glucose (3.82 secs. fast activity/min.).

The complex question arises regarding the possibility that the renal defect possessed by this patient contributes to, or perhaps is responsible for the psychotic emotional lability displayed. While his blood sugar levels are sometimes 90–100 mg. per cent, and more usually in a lower range 54–80 mg. per cent, they have not been observed over 110 mg. per cent. It is possible that these levels, which are normal resting values, might not be adequate for the needs of the brain during periods of stress. Thus, while the normal response to epinephrine brings the blood sugar to a concentration of between 125 and 165 mg. per cent, and the normal renal threshold prevents the loss of this extra sugar making it available for use by the brain, the blood sugar level in this patient cannot be sustained for more than a few minutes above 110 mg. per cent, as illustrated by the results of his glucose tolerance test. An increase in oxygen consumption by the brain has been shown to occur during anxiety (2). At these times this patient's renal disorder would prevent the rise of blood sugar which normally accompanies the increased demands of brain metabolism. An inadequate supply of glucose to the brain during periods of increased cerebral demand for glucose during anxiety could result in a state of what might be termed hypoglycerebral dysfunction.

While frequent feedings rich in galactose, a hexose which he retains in a normal manner, have been associated with clinical improvement in this patient, no conclusions with reference to therapy can be drawn until further cases of this type are studied.

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BRIEF COMMUNICATION

METRAZOL CONVULSIVE THERAPY MODIFIED BY SUCCINYLCHOLINE

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Metrazol, as a means of inducing therapeutic convulsions, was formerly much used. It fell into disfavor probably because of patient fear of the treatment and because of the many fractures induced by the severity of the convulsion. Murray (2) has advocated the use of succinylocholine as a means of overcoming both disadvantages.

This is a report on the treatment of 78 patients at Veterans Administration Hospital, North Little Rock, Arkansas, since January of 1955. This series included 68 cases of chronic schizophrenic reaction. The remainder included one to three cases each of mental deficiency with psychotic reaction, psychotic depressive reaction, chronic brain syndrome secondary to arteriosclerosis, chronic brain syndrome secondary to gross force, grand mal with psychotic reaction and involutional depression.

The age range was 20 years to 68 years with a median of 36 years. Apparent duration of symptoms leading to hospitalization were from two to 30 years with a median of 10 years. All but one patient had been treated with electric and/or insulin shock previously without permanent benefit. None had been previously treated with Metrazol.

METHOD

On treatment days, usually three per week, breakfast is withheld. The patient receives 1/75 gr. atropine sulphate about 30 minutes before treatment, which is usually given on a rolling cart. Any physician capable of handling the rare anoxia can easily do the procedures. The supine patient receives routinely 15 mg. of succinylcholine (Anectine) intravenously. We formerly gave 20 mg. but find that we rarely need this much. The needle is left in place and a syringe with 4–10 cc. of Metrazol is attached and the solution is injected rapidly. Murray (2) has advocated a short waiting period but we have found the time it takes to change syringes is sufficient. After a few seconds there may or may not have occurred a mild tonic phase lasting 10 to 15 seconds followed almost immediately by a mild clonic phase lasting from 10 to 75 seconds. Subconvulsive responses are rare.

We have routinely questioned patients as to discomfort or fear. Only two professed fear. One, although his depression cleared well, clung permanently to the idea that we would give him electric shock while he was unconscious. The other patient said that the treatment made him remember his actions before entering the hospital and that he no longer desired to live with such memories. Incidentally the patient's memories were all seemingly accurate.

Only one patient complained of breathlessness, possibly due to the short interval between succinylcholine and Metrazol injections. No intravenous barbiturates were used. All patients received pre- and post-treatment, x-rays of dorsal and cervical spine.

There were no fractures of the thoracic spine or any other structures during the course of Metrazol treatments, usually 10–16 in all, and there were no complaints of soreness. Pool and Ault (3) found fractures of the thoracic spine in 33 per cent of cases treated with conventional electric shock, *i.e.* without Anectine, and in 19 per cent of

[1] Veterans Administration Hospital, North Little Rock, Arkansas. This paper was read at the American Psychiatric Association, Southern Division Meeting, Miami Beach, Florida, 1958. Metrazol for this study supplied by Bilhuber-Knoll Corporation.

cases treated with differential cerebral stimulation without Anectine. Metrazol with Anectine resulting in zero per cent may be safer than DCS with Anectine resulting in 2.6 per cent (Pool and Ault's data). Fear of impending death has never been mentioned. Apnea has never been a problem since we began to use 15 mg. of Anectine. With 20 mg. we had one patient who routinely required oxygen. The precautions of sand bags, air ways and the like have gradually been abandoned as we gained experience. It is seldom necessary to touch a patient. We have to caution new nursing assistants not to hold them. The jaw is supported lightly.

RESULTS

Twenty-five patients received pre- and post-treatment electroencephalograms. In no case was there a more unfavorable tracing than from "normal" to "slightly abnormal" in tests run within a few days after treatment had terminated. All electroencephalograms returned to their pretreatment state within two months.

Although these patients, as a group, could not be considered to be the best material for the observation of favorable clinical results, it was felt by experienced personnel that improvement was at least equal to that obtained from electroshock therapy upon many of the same patients in the past. Along with clinical study, a systematic evaluation was undertaken to determine the psychiatric effects of the Metrazol therapy as objectively as possible. Twenty patients were evaluated with the "ward observation" portion of the MSRPP (Multidimensional Scale for Rating Psychiatric Patients) before, during and after the treatments. These scales were completed at weekly intervals. In addition, a psychological test battery before and after treatment was administered.

The data show a considerable reduction of overall morbidity during treatment, especially near the time of the sixth treatment and a gross reduction in the pattern of resistive isolation—catatonic withdrawal. Morbidity on the MSRPP dropped from near 19 to below 16. The reduced morbidity was not entirely maintained, but gradually returned toward the higher level as might be expected with this type of patient. The reduced catatonia (dropping from 4.5 units to 3) was maintained for at least one month after treatment stopped. Psychologic test changes consisted generally of increased performance on verbal tasks. These tasks were the Wechsler-Bellevue subtests of similarities, vocabulary, arithmetic, and picture completion. The Porteus Maze Test age was not changed. Nearly all patients improved as measured by the MSRPP, though not quite half did so on the psychologic tests. Those who showed no improvement were no worse, but generally remained unchanged.

We compared the psychiatric and psychological response from Metrazol with that from electric shock therapy, differential cerebral stimulation (DCS). The DCS sample is too small (10) to be conclusive. The morbidity with DCS did gradually drop but not as sharply as with Metrazol. Metrazol does effect a consistent and statistically reliable improvement. Komora and Padula (1) also felt Metrazol with Anectine better than EST or insulin regardless of whether the dominant picture was anxiety or depression. We are in agreement on this point also —Metrazol, more than DCS, made our patients more outgoing, sociable, with better contact and easier ward management.

There were only two difficulties found. Metrazol tends to sclerose veins. This can be reduced if blood is drawn into the Metrazol syringe before injections. Occasionally the dose of Metrazol must be increased. After several treatments, we generally give one or two cubic centimeters more. If necessary, the treatment can be repeated three minutes after an initial injection which rarely may not have produced the desired seizure. The treatment is easily administered to resistive patients—the only difficulty being that of entering some veins.

SUMMARY

We have presented a method of utilizing Metrazol shock therapy which obviates the difficulties which caused its abandonment in former years. Psychiatric improvement with Metrazol therapy, though as with any therapy often not maintained, has been rather satisfactory at this hospital. Results are probably better than with electric shock although an adequate sample of the latter is not presented here. Metrazol in combination with Anectine causes less fear and fewer fractures than does electric shock. There is no need for expensive equipment and fewer personnel are needed. It can be used by any physician who is capable of handling the rare anoxia.

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STEIN, LEOPOLD (WITH ALEXANDER, MARTHA). *Loathsome Women.* McGraw-Hill, New York, 1959. ix + 243 pp. $4.50

The diagnosis "witch" does not appear in the Standard Nomenclature, nor is the Black Art indexed in any of the current psychiatric texts. Leopold Stein, a psychoanalyst of Jungian persuasion now practicing in London, not only made this diagnosis of a number of his patients; he reports that he has successfully treated a series of witches. The present volume is the provocative account of the analyses of four "composite" female patients in this series. Readers in the mental health field who can afford the suspension of disbelief roused by his opening words, "This is a book about witches, modern witches. . . ." may profit thereby, in understanding the psychopathology of the witches of old, if not in dealing with their own patients.

It is, after all, less than 250 years since the last death sentence for witchcraft (never executed) was passed in England, and scarcely five since the publication of a little book entitled *Witchcraft Today* by a Manxman who professes to be "a member of one of the ancient covens of the Witch Cult which still survives" (Gerald B. Gardner). Dr. Stein's patients are not of the conventional snaggle-toothed, wart-nosed, broom-riding variety, however. Nor are they eccentric present-day devotees of necromancy. They are rather, severely neurotic women of a sort familiar to practicing psychotherapists, though undoubtedly not perceived by them as witches.

Why, then, does the author see fit to designate them as such? In the first place, in treating these patients Dr. Stein found himself at the same time strangely fascinated and repelled by them; he experienced uncanny feelings in their presence. Impelled to investigate further the subject of witchcraft, he discovered that all his patients shared a number of traditional signs by which a witch was supposed to be recognized, *e.g.*, all were incapable of weeping real tears. During the course of therapy, he found himself at various times playing—or forced to play—the roles of inquisitor, sacrificial victim, and even the Devil himself.

Aided by his knowledge of myths and legends, and by the interpretation of his own as well as his patients' dreams, Dr. Stein was able to exorcise these women of the unclean spirits which possessed them, or if you will, to aid them on the long, hard road of individuation, through the integration of the rejected masculine aspects of their personalities. A more technical version of *Loathsome Women* appeared in the *Journal of Analytical Psychology* (**1**: 59–77, 1956), of which Dr. Stein is assistant editor. After reading the book, this reviewer made haste to obtain a copy of the earlier paper. The two publications complement each other and both are worth reading, though not guaranteed to convince the skeptic that there *are* "witches among us."

A. B. Silverstein

MIDELFORT, C. F. *The Family in Psychotherapy.* McGraw-Hill, New York, 1957. ix + 203 pp. $6.50

This book reveals its author as a man of courage and conviction. His attempts to relieve the love-starvation—which he regards as central to most psychopathology—of his schizophrenic, depressed, psychoneurotic and psychopathic patients are unorthodox and often exciting. Unfortunately, they are described within a matrix of naive and unsatisfying theory, and even the (not quite, but almost) verbatim accounts of interviews, while revealing, suffer from superficial discussion.

The idea which he has developed most ef-

fectively is that of relating to patients *through* significant relatives. When patients could not tolerate a close relationship with the psychiatrist, they could, in his presence, achieve some emotional contact with the spouses, parents or children from whom they craved it. Or, through observing the conversation between doctor and relatives they could obtain something useful for themselves. Body contact was often important, as when a husband held his insulin-relaxed wife in his arms while he talked about her and himself with the psychiatrist.

The attempts of the psychiatrist himself to use body contact with his paranoid patients seem more questionable. Perhaps this is because the cases described involved women who appear to have been sexually stimulated as he rhythmically stroked and squeezed their foreheads and hands as they lay on a couch with him seated behind. The follow-up data do not suggest that these activities resulted in desirable therapeutic consequences.

The author pays a great deal of attention to the cultural identity of the Norwegian and German Lutheran patients and families of rural Wisconsin where he lives. He feels that the psychiatrist, working with at least one family member, should supply the love which the family requires "to permit constructive socialization"; his own participation in this culture he regards as essential for effective interaction with the families with whom he often speaks Norwegian. This is particularly true for the families of depressive patients, whom he describes as trapped in a "cult of cultural tradition" and able to change only through the acceptance of love, support, and insight from a psychiatrist who is one of their own.

Much of Midelfort's work may be described as brief, superficial, widely-spaced (sometimes at intervals of six months or longer) group therapy with families. His goals are relatively modest and he suggests that this kind of group therapy might often continue throughout the life of the family. In his introduction he makes an important distinction between family-oriented and individual treatment. "... too often, as the patient improves during individual therapy, he pulls away from his family and the gap is widened ...," and speaking of relatives, such as husband and wife seen individually by different therapists, they "... have been so accustomed to the relationship of each with his therapist that their capacity for romance, learning, and forming general principles is dependent on that relationship and may no longer be experienced satisfactorily in the family."

In summary, the psychiatrist who is searching for new therapeutic approaches, particularly to his psychotic patients, will find something of value in this account. His search might have been made easier, however, if the author had offered his clinical material and theory in two or three concise papers rather than in book form.

Eugene B. Brody

RIESE, WALTHER. *A History of Neurology.* MD Publications, New York, 1959. 223 pp., illus. $4.00

For years Dr. Riese, through his many publications, has been widely recognized as an ardent historian interested chiefly in the development of ideas in medicine. In the present volume, this approach is again followed, for as Dr. Riese states, "The history of neurology here offered ... does not tell the story of men, nor does it retrace an unbroken line of discoveries, century by century, decade by decade, eminent as the men were and important as the discoveries proved to be." In his unique way, he weaves concepts with facts—both old and new—in dealing with various phases of neurology, which include *The Function of the Nervous System, The History of the Nervous Impulse, The History of Reflex Action, The History of the Doctrine of Cerebral Localization, The Rediscovery of the Whole, Pain,* and *The History of Diagnosis, Prognosis*

and Therapy in Neurology. In the chapter on cerebral localization, as in others, Dr. Riese discussed critically, in the light of history, many problems with which every neurologist is continually confronted—the concept of "centers," the contrast between the localization of cerebral functions and of cerebral symptoms, the vulnerability of different structures in the brain, restitution and substitution of function (no cerebral structure can ever "take over" activities to which it made no previous contribution), cerebral and spinal shock, release from cerebral inhibition, and so on.

To refresh the reader's memory on the events in the history of neurology, Dr. Riese has included, in table form, a 17-page "Neurological Chronology," which lists the eminent neurologists of the past (from Galen onward) and their main achievements, in relation to the history of civilization and the major events in world history. A list of journals specializing in neurology and another, of the neurological societies and associations of the world (together with addresses), are also provided.

No matter which text or texts in clinical neurology one consults the most, he should have Riese's text as a supplement.

Webb Haymaker

PIERCE, JOHN R. AND DAVID, EDWARD E., JR. *Man's World of Sound*. Doubleday & Co., New York, 1958. 287 pp., illus. $5.00

This volume is an unusually lucid and readable account of many aspects of sound and particularly its part in human communication. The book is written from the point of view of the physicist and the communication engineer. It summarizes the great recent advances in the analysis of the acoustical characteristics of speech, in many aspects of psychoacoustics, *i.e.* the science of "what we hear," in the physiology of hearing, and in the insight yielded by information theory. It deals, among other things, with the intelligibility of speech and with the quality and fidelity of reproduced sounds such as music. The numerous diagrams and graphs throughout the book are particularly clear and helpful. The scope of the book is so wide that no one or two men could be fully expert in all of the fields that are surveyed. The authors have done exceptionally well, however, in summarizing current information and ideas without getting too deeply involved in the technicalities of methods or the interpretation of controversial points. A brief but well-chosen list of more specialized books and monographs is included.

This book may appeal to readers of this journal for two very different reasons. First, it will have a strong non-professional appeal for those who are "hi-fi" enthusiasts. Dealers in hi-fi equipment and recordings often say that physicians as a group are their best customers. Doctors are foremost among those who appreciate the combination of the esthetic pleasure from good music with an additional satisfaction derived from technical excellence of the mechanism that reproduces it. Also they are interested in the reactions of a listener, whether to speech or music, and in the workings of the human sense organs and nervous system. For them, this book should prove fascinating reading.

Second and more importantly, neurologists and psychiatrists have, or should have, a professional interest in the process of human communication by language. For them the mechanism of speech and hearing, the systematic description of man's abilities to hear and to discriminate various sounds, including the sounds of speech, and the many factors that determine the intelligibility of speech constitute a related technical area in which they should be informed. A brief chapter describes common defects of speech and hearing, including those that are due to brain injury. Here the authors quite properly point out that they are laymen, that they are not writing a handbook for the ailing, and that persons with such defects should seek professional advice. Here

the doctor suddenly finds himself in the position of a critic rather than merely an interested reader.

The authors of *Man's World of Sound* permit themselves a little philosophizing here and there. They do not hesitate to point out the importance and also the "wonder" of language and communication. This is quite proper in a semi-technical book, although some readers may object that these discussions are sometimes rather anthropomorphic, as for example when certain physiological mechanisms are characterized as "ingenious." Other readers may feel that the central wonder of nature is not so much communication by language of thoughts and emotions as it is the very existence of the thoughts, memories, and emotions that are to be communicated. This reviewer, who approached auditory communication as a special area of neurophysiology rather than as a branch of acoustics and electrical engineering, is one of these. This is, however, a personal matter. There is no doubt of the central importance of communication in the development of human culture and civilization. It is one faculty that most clearly sets the human species apart from others. In general our "wonder" is likely to be greatest for something that is just outside our own area of expert competence but on which our own interests directly impinge. We marvel particularly at things which we do not fully understand but which we know enough about to recognize both their importance and their complexity. Physics, biology and psychology all present such problems.

Few of us deal with problems that lie entirely within one discipline, but the body of scientific knowledge is too great for anyone to encompass, except in broad outline, the parts outside his immediate area. Each of us gains from the perspective of a summary of a related area. It is exactly that which this book gives: a readable yet accurate and authoritative overview of "man's world of sound."

Hallowell Davis

GREENFIELD, J. G., BLACKWOOD, W., MCMENEMY, W. H., MEYER, A. AND NORMAN, R. M. *Neuropathology*. Edward Arnold Ltd., London (In the U. S., The Williams & Wilkins Co.), 1958. vi + 640 pp., illus. $20.00

The special field of neuropathology is represented by relatively few texts at least in English; certainly by almost none pretending to deal with modern concepts, techniques, problems and interpretation. In fact, from the point of view of a "living," functional approach, most of the study of diseased cells and tissues now appears in the guise of one form or another of physiological or chemical analysis. In other words, the 'modern' pathologist is beginning to be quite different from the classical (and now rather sterile) student of the altered morphology of dead tissue subsequent to its exposure to numerous processes which of themselves radically distort its structure. It is now well known that the time honored "fixation" and "staining" procedures completely destroy any important basis for comparison of cells subjected to them with the normal, or rather the in vivo counterpart. As a result of such developments plus numerous new cell analytical methods (at all levels from molecular orientation and enzyme content and localization to submicroscopic structural determinations with the electron, x-ray, interference, fluorescence, ultra-violet, reflecting and flying-spot microscopes as well as the recent advances in tissue culture techniques) a new generation of pathologists has arisen, and with them new vistas in the study of diseased tissues and the experimental approach to their origin and interpretation. One has only to consider the names of many recent books and journals such as "Analytical Cytology", "Biophysical and Biochemical Cytology," etc. to realize the remarkable change that the last few years have brought about.

It is, thus, with mixed feelings that one considers the present volume which attempts to take into account both the old and

the new. There is no question here concerning the adequate and well-documented coverage of the fundamental classical pictures of neuronal histopathology and general neural tissue disease. Nor is there any doubt that the authors are well aware of the new trends in the field, as evidenced by their statement that, "These new explorations must start from a base of existing knowledge. . . ." Their decision has been to provide the latter and be very tentative about the former. Although this allows for the presentation of such valuable information here, this reviewer, at least, feels a certain disappointment over the fact that it was not decided to minimize the classical by condensation and elimination (of many things that are probably in error anyhow) and to expand consideration of the newer approaches. As far as the material included goes, clear and sensible (and not overenthusiastically misdirected) discussions are presented of neural vascular, infectious, traumatic and demyelinating disease as well as of anoxias, epilepsy and malformations (tumors are covered in a separate volume). A rather unusual chapter is entitled "Psychoses of Obscure Pathology." Not only the chapter, but the exact meaning of its title could be discussed at some length. Suffice it to say that it does a better job of assembling briefly the current knowledge dealing with material relevant to this borderline question of the organic substrate or concomitants of psychosis than can usually be found. There have been some omissions, and as is usual with text books it is already well behind the most recent observations, but it serves as a reasonable introduction to this complex and fascinating area of investigation.

Certainly the volume will be a useful addition to the libraries of all those concerned with nervous system problems. It is an elegant book, very beautifully done—which it should be for its not inconsiderable price.

Robert G. Grenell

RENDER, HELENA W. AND WEISS, OLGA M. *Nurse-Patient Relationships in Psychiatry*. 2nd ed. McGraw-Hill, New York, 1959. vii + 319 pp. $5.95

The present volume is a revision of a pioneer work published in 1947 under the same title by the senior author. It purports to present an up-to-date approach in nursing care of the mentally ill for basic nursing students.

This textbook begins with a statement of the meaning and objectives of psychiatric nursing which is debatable in many ways. While other professions such as social work and psychology, and other nurse authors, forge ahead in indicating how treatment of psychiatric disturbance involves interpersonal relationships among any one or all professional workers and the patient, this work states that, "treatment is essentially an interpersonal relationship between the patient and the physician." Moreover, the text asserts that "the study of psychiatric nursing pivots around pathological behavior" while other nurse authors point out the importance of the nurse also studying the assets—the healthy behavior of the patient—and favoring further development along these lines.

In comparing this new edition with the first one there are very few significant additions. The table of contents is almost identical. A new bibliography, a different description of schizophrenia and sociopathic disturbances, a section on dance therapy, the inclusion of some legal aspects, and a reference to psychosomatic illness are among the favorable changes. Moreover, procedures for holding patients have been omitted which this reviewer saw as an improvement. Many of the more recent functions of the nurse in psychiatric work are *not* included, for example—group work, problems in one-to-one relationships, ward milieu management, and leadership of the nursing team.

The first edition was such a radical departure from previous symptom-centered